AFML-TR-75-186

12

ADA022145

AN INVESTIGATION OF THERMOPLASTICS FOR USE AS 20mm ROTATING BANDS

UNIVERSITY OF DAYTON RESEARCH INSTITUTE
DAYTON, OHIO 45409

NOVEMBER, 1975

TECHNICAL REPORT AFML-TR-75-186
TECHNICAL REPORT FOR THE PERIOD OF DECEMBER, 1973 – JULY 1975

Approved for public release; distribution unlimited

AIR FORCE MATERIALS LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio 45433

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This technical report has been reviewed and is approved for publication.

EDWARD J. MORRISEY
Project Monitor

FOR THE COMMANDER

ALBERT OLEVITCH, CHIEF
Materials Engineering Branch
Systems Support Division

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: AFML-TR-75-186 — 2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): AN INVESTIGATION OF THERMOPLASTICS FOR USE AS 20mm ROTATING BANDS	5. TYPE OF REPORT & PERIOD COVERED: Technical Report, Dec [redacted]73 to July [redacted]75
	6. PERFORMING ORG. REPORT NUMBER: NONE
7. AUTHOR(s): D. R. Askins	8. CONTRACT OR GRANT NUMBER(s): F33615-74-C-5024
9. PERFORMING ORGANIZATION NAME AND ADDRESS: University of Dayton, 300 College Park, Dayton, Ohio 45469	10. PROGRAM ELEMENT PROJECT TASK AREA & WORK UNIT NUMBERS: 7381/01/34
11. CONTROLLING OFFICE NAME AND ADDRESS: Materials Engineering Branch (MXE), Systems Support Division (MX), AF Materials Laboratory (AFML)	12. REPORT DATE: Nov[redacted]75
	13. NUMBER OF PAGES: 84
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): AF Materials Laboratory, Air Force Systems Command, Wright-Patterson AFB, Ohio	15. SECURITY CLASS. (of this report): UNCLASSIFIED
	15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

HF-7381 738101

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

NONE

18. SUPPLEMENTARY NOTES

NONE

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Rotating bands, plastic, 20mm, bonded, development, testing, screening, gunfire, thermoplastics, adhesives, injection molded

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An empirical investigation has been conducted to screen a wide variety of plastic and adhesive candidate materials for use in 20mm rotating band systems. Eighteen different polymeric materials, representing seven general polymer families were used as rotating bands. Eleven different adhesives representing eight general types were utilized with the eighteen band materials to provide a total of forty-nine band material/adhesive combina-

105400

tions. Numerous processing variables were also investigated with the result that a total of one hundred thirty-one processing/material combinations were tried.

The net results of this investigation was the identification of four material combinations which demonstrated substantial promise of serving as alternate materials to the nylon 12-253P rotating band system. Three of these four employ a domestically produced nylon 6 material (Zytel 211) with three different adhesives, P104, P-3, 253P. The fourth is a French produced nylon 11 material (BMNO) with the 253P adhesive. Gunfire results are presented and discussed and recommendations for following up the work conducted in this program and optimizing the performance of the most promising materials are made.

PREFACE

This final report was submitted by the University of Dayton Research Institute, Dayton, Ohio under contract number F33615-74-C-5024, 7381/01/34, with the Air Force Materials Laboratory, Wright Patterson Air Force Base, Ohio. Mr. E. J. Morrisey was the laboratory project monitor.

TABLE OF CONTENTS

SECTION	TITLE	PAGE
I	INTRODUCTION AND BACKGROUND	1
II	TECHNICAL DISCUSSION	3
	A. Approach	3
	B. Materials Investigated	3
	C. Fabrication Procedures	4
	D. Testing and Evaluation Procedures	5
	E. Experimental Results	12
III	CONCLUSIONS	26
IV	RECOMMENDATIONS	29
APPENDIX A	MATERIAL UTILIZED DURING 20mm ROTATING BAND INVESTIGATION	30
APPENDIX B	MOLDING PARAMETERS AND BONDING PROCEDURES USED TO FABRICATE PLASTIC ROTATING BANDS	37
APPENDIX C	TEST DATA	67
REFERENCES		84

LIST OF ILLUSTRATIONS

FIGURE NO.		PAGE
1.	Falling Dart Test Apparatus	6
2.	Typical In-Flight Photographs of Gunfire Test Specimens	10
3.	Typical In-Flight Photographs of Gunfire Test Specimens	11

LIST OF TABLES

TABLE NO.		PAGE
1.	SPECIMEN NUMBER, MATERIALS, AND TEST CONDITIONS FOR IN-FLIGHT PHOTOGRAPHS OF FIGURES 2 AND 3	8
2.	ROTATING BAND SYSTEMS EVALUATED IN GUNFIRE TESTS AT AFATL	13
3.	SUMMARY OF BEST RESULTS FOR THE ZYTEL 211/253P SYSTEM	20
4.	GUNFIRE RESULTS FOR ZYTEL 211/P3 PREBAKED AT 450°F BEFORE MOLDING	22
5.	GUNFIRE TEST RESULTS FOR ZYTEL 211/P3 PREBAKED AT 550°F BEFORE MOLDING	23
6.	GUNFIRE TEST RESULTS FOR ZYTEL 211/P104	25

I. INTRODUCTION & BACKGROUND

A rotating band is that part of a projectile which extends above the diameter of the basic projectile body and which engages the lands and grooves on the interior of rifled gun barrels. It consists of a relatively soft material which must serve as a seal to prevent gaseous products of propellant combustion from escaping around the projectile and must be firmly anchored to the projectile to impart spin as the projectile accelerates through the gunbarrel. In addition, the rotating band must possess sufficient integrity that it does not fray, crack, or break up either in the gunbarrel or in free flight after exiting the barrel.

The United States has been using relatively soft metals such as copper for many years for rotating bands. There are a number of disadvantages associated with the use of metallic rotating bands but the problems become most pronounced at high rates of fire and high muzzle velocities. Under these conditions one of the major problems becomes gunbarrel wear or erosion. This situation has been recognized for many years and a substantial effort has been invested over the years to investigate and develop alternate materials to the soft metals for use as rotating bands. These efforts are well summarized in a number of publications [1, 2] and will not be further reviewed here. The University's involvement in an investigation of this nature commenced in December of 1973 and continued until July, 1975, concentrating on the 20mm projectile.

At the time the writer became involved in the program, the status of the program was that:

(a) Nylon 12 had been found to work adequately but it was not manufactured domestically and was expensive. It was desired that a less expensive material which was domestically manufactured be found.

(b) A less expensive molding technique than ring-gate/insert molding was desired.

Item (b) had already been addressed by the Materials Engineering Branch (MXE) of the Air Force Materials Laboratory (AFML). The proposed solution employed an improved mold design to reduce material waste and machine time. The new technique employs side gating and produces weld lines where the molten polymer flows around the projectile from opposite sides and meets. Weld lines are reputed at best to be only 80 to 90% as strong as weld free portions of the band [2] but in our experience, no failures whatsoever have been associated with the weld lines. The original objective of the effort reported here, consequently, was to investigate alternative materials and adhesives so as to replace nylon 12 with an inexpensive, domestically available band material. Several considerations changed during the course of the program. One of the earliest changes was the dropping of the expense criteria. The desire was to simply find a domestically available alternate to nylon 12, regardless of cost. This was to be accomplished by using a one-half inch long band with no bevel on either the leading or trailing edges, even though it was already known at this time that a bevelled angle on both the leading and trailing edges improved band performance. It was also learned, several months into the effort, that the ultimate band length would have to be reduced to 0.28 inches instead of 0.50 inches. Since by this time a 0.50 inch mold insert was available, it was agreed that work could proceed using the 0.50 inch length. The primary aim at this point was to find a material equivalent or superior to the nylon 12 material, and it was felt that this could be accomplished with the 0.50 inch band length simply by comparing the performance of 0.50 inch nylon 12 bands to that of 0.50 inch bands of the various candidate materials.

II. TECHNICAL DISCUSSION

A. Approach

At the time that the University became involved in this program, no quantitative information was available regarding the strength, toughness, or other property levels required of the band material or adhesive in order to achieve acceptable performance over the required temperature range (-65°F to 160°F). Further, only a qualitative, and even for that matter relatively speculative, idea existed regarding the loading modes which a rotating band and its adhesive would be subjected to during gunfire. The approach adopted therefore was largely an empirical one guided by the judgment and experience of the author and the AFML program monitor. In general, materials were sought which possessed and retained down to -65°F, a degree of impact resistance comparable or superior to the nylon 12 material. For each band material investigated, one or more adhesives were tried. The adhesives tried were either recommended by the band material supplier or were members of the general class of adhesives recommended for use with that type of material [3].

B. Materials Investigated

During the course of the experimental effort, eighteen specific thermoplastic band materials, representing seven general families of polymers, were investigated. Eleven specific adhesives representing eight general types were utilized during the program as well as four different adhesive primer materials. A total of forty-nine band material/adhesive/primer combinations were fabricated and evaluated. Superimposed upon this total were numerous processing variations such as projectile surface preparation and adhesive/primer curing schedule. The total number of different processing/material combinations examined therefore ran well over one hundred.* Tables A-1 through A-3 list the materials used in this program while Table A-4 lists the material/adhesive/primer combinations investigated.

*Appendices A and B summarize the materials and processing combinations investigated in this program.

C. Fabrication Procedures

All of the rotating bands evaluated during this program were injection molded on a Newbury-Eldorado, 75-ton, 3-ounce injection molding machine. The molding parameters used to fabricate all the various sets of rotating band samples are tabulated in Appendix B. Any subsequent adhesive bonding operations to which the banded samples were subjected to culminate bonding are also presented in Appendix B.

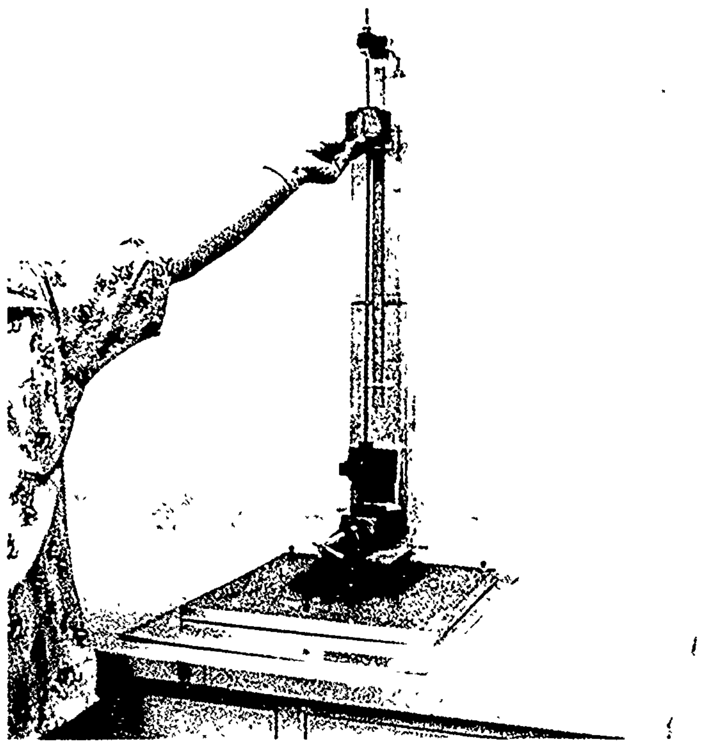
In essence, the sample fabrication process consisted of four general phases. The first consisted of the preparation of the projectile surface for bonding. This phase consisted of a number of substeps including grit or glass bead blasting, methyl ethyl ketone (MEK) degreasing and air drying. The second phase consisted of application of the adhesive. This could have been a simple dip or brush coating or the wrapping and heat tacking of a tape-type adhesive onto the surface. In some cases, a base primer coat had to be applied before the adhesive itself and in some cases the adhesive required a bake after application but prior to molding of the band. The third phase was the injection molding of the band itself while the fourth phase was the post molding bond completion. Although in most cases, the adhesive application, molding and bonding conditions recommended by the manufacturer were utilized, some variations in these processing parameters were introduced during the course of the program with some of the band materials and adhesives. These variations were aimed at improving the performance of the various systems over that achieved with the recommended processing conditions. For the most part, the specific details of the processing of the various band and adhesive combinations will not be discussed in the text since this information is quite cumbersome and can be obtained from Appendix B if desired. In a few instances however, salient variations in the processing parameters which led to significantly improved or reduced performance levels will be discussed.

D. Testing and Evaluation Procedures

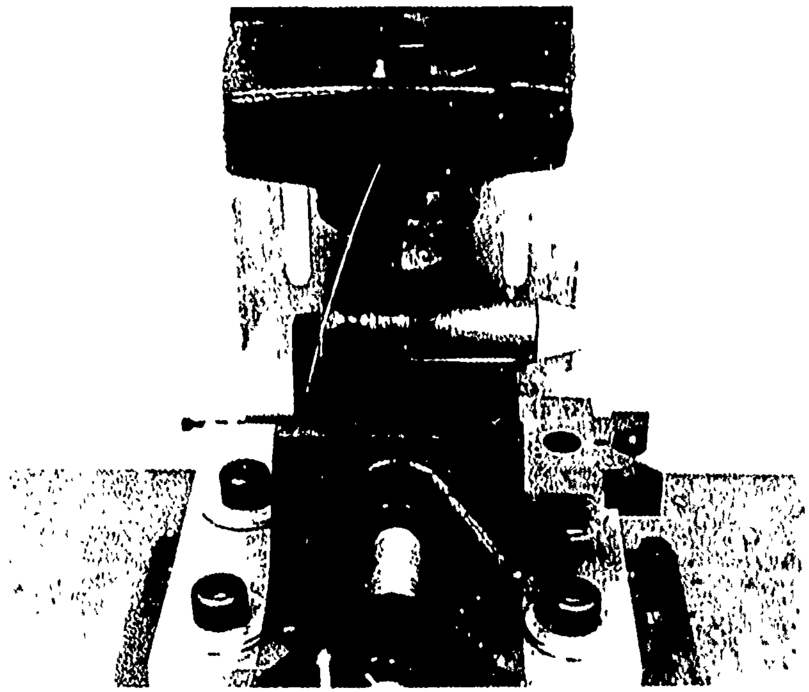
Early in the program, it was requested that some sort of screening technique be developed and utilized to simulate the effects of gunfire testing and reduce the number of gunfire tests required to evaluate the various materials. A falling-dart type impact tester was suggested as having served this purpose well in other similar studies. Accordingly, a falling-weight impact tester already available at the University was modified for this purpose. Figure 1 illustrates this test device. It is capable of dropping a one, two, or four pound weight from any height up to eight feet onto a sample. The sample rests in a V-block and is impacted by a blunted knife edge 0.0735 inches wide, a dimension comparable to the width of a rifling land. The length of the knife edge is one inch, which is longer than the band, and is aligned along the projectile axis so that the excess length serves to limit penetration to the surface of the main projectile body, the same situation encountered in a gunbarrel.

A series of falling dart tests on nylon rotating band specimens was conducted early in the program to determine if any difference in performance was manifested with various combinations of dropping weight and drop height. It was found that for equivalent impact energy, equivalent band performance was obtained, regardless of the combination of weight and drop height used to attain the impact energy. Consequently, all further screening tests were conducted with a four pound weight, different impact energies being achieved simply by varying the drop height.

The falling dart impact test described above was used to screen the many materials examined during the course of this effort and to identify those which looked promising enough for further evaluation in an actual gunfire test. The gunfire tests were conducted at the Air Force Armaments Laboratory (AFATL), Eglin AFB, Florida. Barrel number 23, a 30/20 barrel with a constant twist of one twist in 24 inches was employed. Thirty millimeter cartridge cases were employed to achieve the desired velocities



(a) Total view, showing falling mass, guide rod, impact nose, specimen, and base.



(b) Closeup, showing impact nose resting on banded sample in V-block.

Figure 1. Falling Dart Test Apparatus

but were necked down to 20 millimeters to accomodate the projectiles. Tests were conducted at a nominal muzzle velocity of 4000 fps. Maximum chamber pressure and projectile exit velocity were recorded during the test and an in-flight photograph of the specimen was taken to permit inspection of the condition of the rotating band after its exit from the barrel. Tests were conducted at room temperature, -65°F, and 165°F. Figures 2 and 3 represent typical in-flight photographs illustrating the various types of rotating band conditions seen in a gunfire test and which are discussed in the text and listed in Appendix C. Table 1 lists the specifics for each specimen photograph in Figures 2 and 3 so that the reader may cross reference the photographs and the test results tabulated in Appendix C.

Use of a constant-twist barrel is an admittedly more severe test condition than the projectile would see in a gain-twist barrel, which is the type in service. The rationale for using the constant-twist barrel, however, was that since it did represent the more severe condition, a material which performs successfully in this situation would have a built-in margin of safety in the less taxing gain-twist system. Late in the program effort, some shots were fired with a gain-twist barrel and as expected, band performance was significantly better.

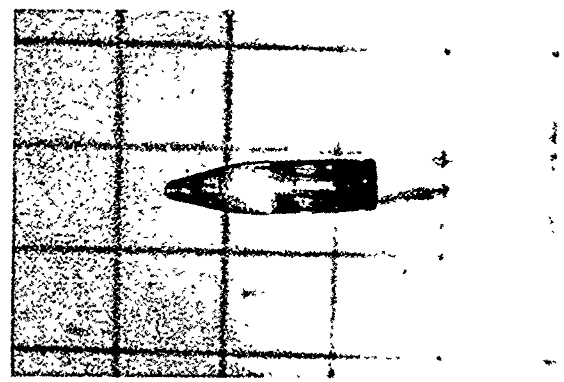
Examination of all the test data accumulated during this program from both the falling dart and gunfire tests leads to a number of conclusions regarding correlation of material performance in the two different tests. First, it must be noted that, by far, the bulk of the falling dart tests were conducted using an eight foot-pound impact energy. This level was selected because the nylon 12-253P system was capable of surviving falling dart impacts at this energy level at all three test temperatures (-65°F, 72°F, 165°F) without fracture or debonding. It was reasoned that since we did not know what impact energy level corresponded to a material's ability to perform satisfactorily in a gunfire test, selection of an impact energy level which the nylon 12-253P (the best gunfire performance found to date)

TABLE 1

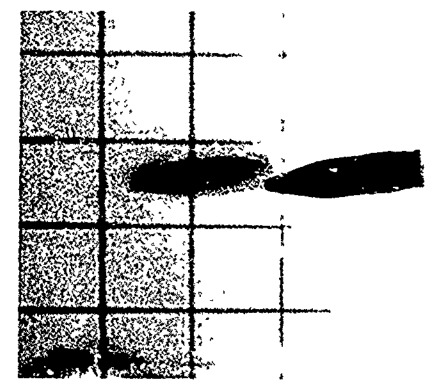
SPECIMEN NUMBER, MATERIALS, AND TEST CONDITIONS FOR IN-FLIGHT PHOTOGRAPHS OF FIGURES 2 AND 3

AFATL Shot No.	Specimen Number	Band/Adhesive Combination	Test Temp.	Interpretation of Photograph
685	80-22	BMNO/253P	75°F	Pass - Band fully intact.
431	75-14	Zytel 158/253P	75°F	Pass - Slight fraying at rear edge.
418	76-12	Zytel 158/P3	75°F	Fail - Small piece off rear edge.
383	90-17	Zytel 211/253P	75°F	Fail - Large piece lost.
365	75-3	Zytel 158/253P	75°F	Fail - Entire band lost.
416	90-82	Zytel 211/253P	75°F	Photo blurred - band looks intact but may be slightly frayed.
417	76-11	Zytel 158/P3	75°F	Photo blurred - band looks intact but may be very slightly frayed.

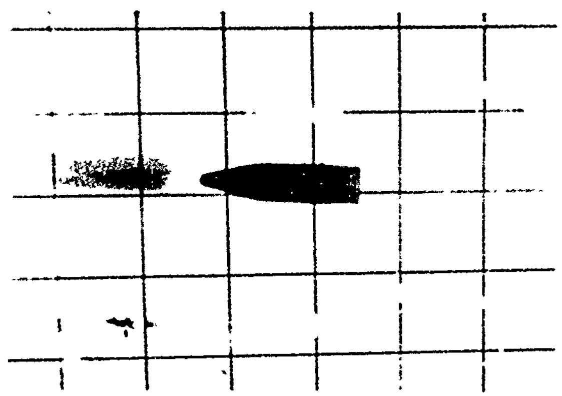
could withstand would serve as a useful starting point. In retrospect, it appears that the use of eight foot-pounds impact energy does provide a fairly reliable indication at 72°F of a material's ability to perform well in gunfire tests at 72°F. At -65°F, however, the falling dart impact test using eight foot-pounds appears to be too severe a condition since every combination tested with the falling dart apparatus at this temperature except for the nylon 12-253P system experienced fracture or debonding or both. Some materials which looked poor in the falling dart tests at -65°F, however, looked rather encouraging in gunfire tests at this temperature. At 165°F, on the other hand, most materials tested with the falling dart looked quite suitable, although these same materials did not perform as consistently well in gunfire tests at this temperature. What all this means is that these materials may not be as good as the nylon 12-253P system in resisting this type of impact, particularly at the lower temperature, but that they still may be good enough to survive a gunfire test. The fact that a falling dart impact test is strictly a compressive test while a rotating band during gunfire sees not only compressive but also shear stresses undoubtedly contributes to this less than perfect correlation between the two. All of these considerations indicate a need to know the actual stress levels encountered by a rotating band during gunfire at different temperatures and how various combinations of material mechanical properties affect and respond to these stresses.



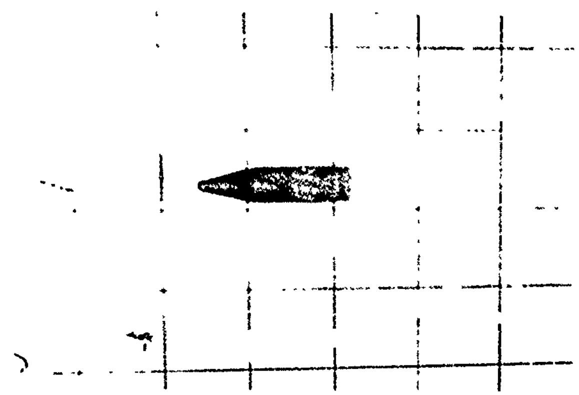
(a) Shot No. 685 - Pass; band fully intact.



(b) Shot No. 431 - Pass; slight fraying at rear edge.

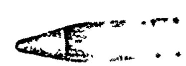


(c) Shot No. 416 - Photo blurred; band looks intact but may be slightly frayed.

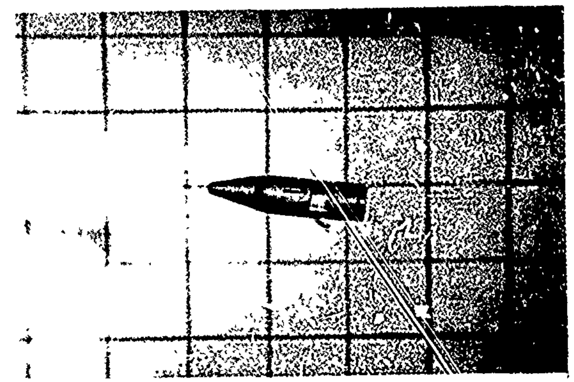


(d) Shot No. 417 - Photo blurred; band looks intact but may be very slightly frayed.

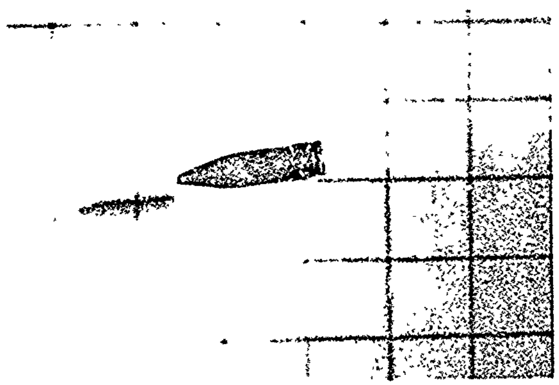
Figure 2. Typical In-Flight Photographs of Gunfire Test Specimens.



(a) Shot No. 418 - Fail; small piece off rear edge.



(b) Shot No. 383 - Fail; large piece lost.



(c) Shot No. 365 - Fail; entire band lost.

Figure 3. Typical In-Flight Photographs of Gunfire Test Specimens

E. Experimental Results

As mentioned in Section IIB, a total of forty-nine band/adhesive/primer combinations were fabricated and evaluated, and the number of processing variations superimposed upon this total brought the total number of processing/material combinations to over one hundred. Each of these combinations were screened with the falling dart test to see how well they performed in comparison with the best material found to date, nylon 12 bonded with 253P adhesive primer. The screening tests were conducted at 72°F and any material performing well at this condition was then impacted at -65°F and/or 165°F. Only those materials which looked promising in the falling dart screening test were forwarded to AFATL for gunfire testing.

Most of the materials fabricated and screened during this program did not perform well in the falling dart tests, experiencing either band fracture or debonding from the projectile substuate as a result of the impact. Rather than expand individually on the test results for each single material and processing variation, the results for all the materials are summarized in Appendix C. Only those systems which appeared promising and were sent to AFATL for gunfire tests will be discussed individually in the text, with brief summaries of the results for other systems presented in the conclusion section starting on page 26. This reduces the descriptive task to manageable proportions since only eight combinations were subjected to gunfire testing at AFATL. All of these eight combinations involved nylon bands (nylon 6, nylon 6/12, nylon 11, and nylon 12) and epoxy-phenolic (P3 and P104) or a proprietary epoxy type (253P) adhesive. One of the eight was the nylon 12/253P combination which has proven to be the best material system found to date for 20mm rotating bands fired at 4000 fps. Table 2 lists the eight combinations which will be individually discussed.

TABLE 2

ROTATING BAND SYSTEMS EVALUATED IN GUNFIRE TESTS AT AFATL

Band Material	Material Designation	Adhesive
Nylon 12	L1901	253P
Nylon 11	BMNO	253P
Nylon 11	BMNO	P3
Nylon 6/12	Zytel 158	253P
Nylon 6/12	Zytel 158	P3
Nylon 6	Zytel 211	253P
Nylon 6	Zytel 211	P3
Nylon 6	Zytel 211	P104

L1901-253P

At the time that the University became involved in this effort, the nylon 12/253P system had already established itself as the best performing system yet tested. It's performance was reputed to be fully adequate at ambient conditions and at -65°F, but at 165°F it's performance was not fully satisfactory due to softening. Further, since the material was not domestically manufactured, the whole object of our program was to find a domestically produced alternative. As a first step, however, several series of rotating bands using this material were fabricated to establish the level of impact energies which this system was capable of sustaining in the falling dart screening test. This would then serve as a goal for other materials systems to aim for if they were to equal or surpass the performances of the nylon 12 systems. After fabricating a series of nylon 12/253P rotating band specimens and subjecting them to falling dart screening tests, it was found that this system was capable of sustaining an impact energy of eight foot-pounds at all three test temperatures, -65°F, ambient, and 165°F, without visible damage other than the indentation from the blunted nose of the dart. Later in the program, in fact, it was learned that this level of performance was achieved by the nylon 12/253P system in an 0.200 inch band length as well as the 0.500 inch length. A set of L1901-253P rotating band specimens was consequently sent to AFATL for gunfire testing. This set contained five specimens. All five were fired at ambient conditions and all five rotating bands were fully retained after leaving the test barrel. These bands had a 30° bevel on the front edge but none on the rear edge and since these were the locations of the observed imperfections, it is possible that with a more gradual bevel on the front and rear edges, the samples would have exhibited no imperfections at all. At any rate, the fact that all five samples passed was in accord with previous results and verified that our fabrication procedures were capable of producing rotating band specimens equivalent to those produced by other laboratories working in this area.

BMNO-253P

The close similarity of nylon 11 to nylon 12 (eleven carbon atom sequences in the chain backbone rather than twelve) made it an obvious choice to investigate since the nylon 12 had proved adequate. The fact that the nylon 11 source is located in France rather than the U.S.A. was a known drawback, but it was felt that if the material proved technically satisfactory, an alternate to the German-made nylon 12 would be a better situation than no alternate at all.

A series of BMNO/253P rotating band specimens were consequently prepared. Falling dart screening tests on this material system indicated that it was equivalent to the nylon 12/253P system at ambient and 165°F, but inferior at -65°F. At the low temperature the nylon 11 system experienced both fracture and debonding from the projectile when impacted with eight foot-pounds. Because of the good performance at the two higher temperatures, a set of fifteen samples were sent to AFATL for gunfire testing. Five were to be fired at each of the three test temperatures. At ambient conditions, one photograph was not obtained when the camera malfunctioned. Of the remaining four, three passed the gunfire tests with no visible damage to the bands other than the engraving grooves, apparent in the photographs. The specimen which failed had lost the rear two-thirds portion of the band between two of the engraving grooves and a small piece from the rear of the adjacent between-groove section. All five specimens fired at 165°F were intact and therefore passed the test, although a very slight amount of fraying appeared to occur on the leading or trailing edges. All of the muzzle velocities of the 165°F shots were slightly lower than the 4000 fps target velocity (3946-3986 fps). This might be attributable to a softening of the material at this temperature with a subsequent failure to build up sufficient back pressure in the breech to impart a higher velocity for a given charge.

At -65°F, one specimen was not tested for unstated reasons. Of the remaining four, one specimen passed while three failed. Of the three failures, one sample had lost a small piece of the band from the front edge of the band while the other two lost half or more of their bands. Again, the above shots were conducted on samples which had a 30° bevel on the leading edge and none on the trailing edge and most all of the damage inflicted upon the bands was at one of these two locations.

BMNO-P3

In addition to the 253P adhesive used with the nylon 12 (L-1901) and nylon 11 (BMNO), an additional adhesive, sold by the same company that handles the BMNO resin, was tried. This adhesive, P3, was developed especially for use with nylon 11 and was tried, not only here, but also later with other types of nylon.

A relatively small series of BMNO/P3 specimens were prepared. In the falling dart screening test this system looked satisfactory at ambient conditions. A set of five samples were forwarded to AFATL for gunfire testing. Four of the five were fired with three of these four losing half or more of the band during firing, predominately from the rear edge of the bands. The fourth specimen might also have lost a part of the band but the in-flight photograph was difficult to interpret. These specimens also had a 30° bevel on their front edges and none on the rear.

Zytel 158-253P

The wide domestic availability and relatively low cost of type 6/12 nylon made this material a desirable candidate for evaluation. The molecular structure of nylon 6/12 would lead one to hope that its higher stiffness and melting point combined with its more frequent spacing of carbonyl groups would simultaneously serve to provide better 165°F performance than nylon 12 and also more sites for adhesive bonding to the projectile substrate.

Several sets of Zytel 158 rotating bands were prepared using 253P as the adhesive. It was reasoned that an adhesive which bonded to nylon 12 (which 253P does) should bond even better to nylon 6/12 because of the higher concentration of carbonyl sites. Several processing parameters, such as mold temperature and length of adhesive prebake time, were varied for these different sets of specimens. Unfortunately, the test results for the Zytel 158 material were not particularly good. Although some evidence of success was obtained, the Zytel 158/253P system by no means measured up to the performance of the nylon 12 system. It was found that the Zytel 158/253P system performed best when the 253P adhesive was not subjected to quite as long a prebake as with the nylon 12 system. The primary observable difference between these two conditions is the color of the 253P film at the end of the prebake period, being a light amber or honey color for the optimum Zytel 158 condition and a darker amber for the optimum nylon 12 condition. In the falling dart screening tests, the Zytel 158/253P system proved satisfactory at $72^{o}F$, but at $-65^{o}F$ its performance fell considerably short of that of the nylon 12 system. In order for the 6/12 material to survive a falling dart impact at $-65^{o}F$, the impact energy had to be reduced to four foot-pounds (the L1901/253P system survived an eight foot-pound impact). In gunfire tests, the Zytel 158/253P system, even at $72^{o}F$, fell considerably short of the nylon 12 performance. Samples from three different sets of Zytel 158/253P banded projectiles were fired at ambient conditions. All of the bands from two sets failed to perform satisfactorily. Of the three samples from the third set, one had clearly lost nearly the entire band, and while the photographs for the other two were too dark and blurred to interpret accurately, it appeared as though the bands on these two might have been substantially intact. All of the Zytel 158/253P samples which were gunfire tested had a 30^{o} bevel on the leading edge and no bevel on the trailing edge. At any rate, of the total of six projectile samples fired from the three different sets, four were clear failures and two were questionable. This is in marked contrast to the near 100% success rate achieved by the nylon 12/253P system.

Zytel 158-P3

This band material/adhesive combination employs an adhesive marketed for use with nylon 11 but which, by the same reasoning stated in the previous section, was felt worth evaluating with the nylon 6/12 also. A total of four sets of samples were fabricated using this combination with about the same results as with the Zytel 158/253P system. The falling dart screening tests conducted at 72°F all resulted in satisfactory performance but at -65°F the result was uniformly poor with the band fracturing and debonding from the substrate projectile even at impact energies as low as four foot-pounds. In the gunfire tests at ambient conditions, a total of ten samples from three different sets were fired. Of these samples, only one was clearly intact after firing while two others might have been intact but blurred photographs made it difficult to tell for sure. Of the remaining seven, four were clear failures while the other three appeared to have lost portions of the band, but blurred photographs preclude an unequivocal statement to that effect. Just as with all the systems mentioned previously, the Zytel 158-P3 samples discussed here had a 30° bevel on the front edge of the band but a blunt rear edge.

Zytel 211-253P

Nylon 6 possesses a number of desirable features for consideration as a rotating band material. It is widely available domestically, it is relatively inexpensive and its chemical structure is very similar to that of nylon 12, the difference being that the repeating unit is half as long.

Four sets of Zytel 211-253P rotating band specimens were fabricated. Several processing parameters were varied during the fabrication of these specimens, including the temperatures at which the adhesive was baked prior to molding, the elapsed time between adhesive application and molding, and the temperature to which the projectile was induction heated subsequent to molding in order to consumate the bond. It was found that certain combinations of these processing variables produced rotating bands which performed very well at ambient conditions and which also showed considerable promise at -65°F and 165°F. The best results obtained during this program with the Zytel 211/253P combination are briefly summarized in Table 3. It has been found that the projectile surface must be induction heated to about 500°F after molding to develop an adequate bond between the nylon band and the projectile. In fact, it has been found that repeating this induction heating process a second time improves the bond over just one heat-up. In each case, the sample was quenched in cold water immediately after induction heating to prevent warpage or distortion of the band. It has also been found that the degree of prebaking of the 253P adhesive can be a very significant factor in the ultimate performance of the rotating band. It was our experience that simply placing the adhesive coated samples in a circulating air oven set at 450°F for 45 minutes could not be depended on to yield reproducible results. This was apparent from the observable differences in adhesive color after ostensibly identical bakes. Inaccuracies in temperature control or temperature gradients within the oven are most likely responsible for this problem. It has been found that if the prebake is conducted as long as necessary to produce a shade of amber comparable to that in a beer bottle, without regard to the length of time required, the optimum prebake has been achieved. One other variable which was not optimized in this effort is mold temperature. All of the Zytel 211-253P samples were molded in a 230°F mold. Conceivably, use of a lower mold temperature could produce a more amorphous polymer structure and thereby increase the flexibility of the material and enhance its ability to perform satisfactorily at -65°F. In summary, as shown in Table 3, a very limited number of tests show that this material combination performs excellently at 72°F and shows sufficient promise at -65°F and 165°F to justify further work and process parameter studies. Contrary to the somewhat reduced muzzle velocities noted with the BMNO system at 165°F, the Zytel 211 results cited in Table 3 at 165°F all had muzzle velocities in the range 4026 to 4119 fps, which is almost identical to the 72°F muzzle velocity range and indicates that softening at 165°F occurs to a significantly lesser

TABLE 3

SUMMARY OF BEST TEST RESULTS FOR THE
ZYTEL 211/253P SYSTEM

Specimen Number	Test Temperature (^{o}F)	Falling Dart Result (8 ft lbs)	Gunfire Results (Bands had 15^{o} bevel on leading edge, 6^{o} bevel on trailing edge)
90-69	75	Pass	---
90-64	75	---	Pass
90-68	75	---	Pass
90-75	75	---	Pass
90-76	75	---	Pass
90-85	75	---	Pass
90-81	-65	Piece fractured	---
	-65	and debonded	---
90-62	-65	---	Pass
90-66	-65	---	Pass
90-72	-65	---	Large piece off.
90-78	-65	---	Pass
90-83	-65	---	Photograph difficult to interpret. May be . very small piece off of leading edge.
90-63	165	---	Pass
90-67	165	---	Cannot interpret photo accurately.
90-74	165	---	May be slight fraying but photo blurred.
90-80	165	---	Pass
90-84	165	---	Photo blurred and hard to interpret but a very small piece may be off of leading edge.

degree with the Zytel 211 than with the BMNO or nylon 12 material. All of the data in Table 3 are for samples with a 15° bevel on the leading edge and a 6° bevel on the trailing edge. A previous set of five Zytel 211-253P samples fired at 72°F with a 30° bevel on the leading edge and no bevel on the rear edge resulted in three clear successes and two which were difficult to interpret because of blurred photographs but which looked satisfactory for the most part with perhaps some slight fraying.

<u>Zytel 211-P3</u>

Three sets of Zytel 211-P3 samples were fabricated. Falling dart tests were conducted on samples from each of these sets and gunfire tests were conducted on samples from two of the sets. In each case, the falling dart impact test at 72°F resulted in neither fracture or debonding, while at -65°F both fracture and debonding occurred in the large majority of cases. One sample at -65°F did not fracture but it did experience some debonding. Of the two sets from which samples were gunfire tested, one was subjected to an adhesive prebake before molding of 450°F for 45 minutes while the other was prebaked for 10 minutes at 550°F. Tables 4 and 5 present the gunfire test results obtained for these two sets of samples. It is difficult to see a significant difference between the overall gunfire performance of the two different sets. Comparison of the data in these tables with that in Table 3 leads to the observation that there appears to be little to choose between the P3 or the 253P adhesive for Zytel 211 rotating bands. As with the Zytel 211-253P samples, all of the Zytel 211-P3 samples were molded with a mold temperature of 230°F and use of a lower mold temperature could help improve the flexibility of this material and improve its gunfire performance. It is also possible that further variation of the adhesive prebake condition could result in improved overall gunfire performance.

<u>Zytel 211-P104</u>

The same company which developed the P3 adhesive for use with nylon 11 also offers a P104 adhesive which was developed for use with electrostatically

TABLE 4

GUNFIRE TEST RESULTS FOR ZYTEL 211/P3
PREBAKED AT 450°F BEFORE MOLDING

Specimen Number	Test Temperature (°F)	Gunfire Results
91-17	75	Pass
91-18	75	Pass
91-21	75	Pass
91-29	75	Pass
91-32	75	Pass
91-19	-65	Fail-Very small piece off rear edge.
91-26	-65	Fail-Piece off rear edge.
91-30	-65	Pass
91-33	-65	Fail-Piece off rear edge.
91-11	165	Pass
91-12	165	Fail-Piece off around rear edge.
91-16	165	Pass
91-25	165	Pass
91-35	165	Fail-Slight fraying at rear edge.
91-23	75	Fail-No pieces lost but some fraying.
91-27	75	Pass
91-28	75	Fail-No pieces lost but some fraying.
91-34	75	Pass

Note: First 14 specimens in table had 15° bevels on leading edge and 6° bevels on trailing edge. Last 4 specimens had no bevel on rear edge but had a 30° bevel on front edge.

TABLE 5

GUNFIRE TEST RESULTS FOR ZYTEL 211/P3
PREBAKED AT 550°F BEFORE MOLDING

Specimen Number	Test Temperature (°F)	Gunfire Results
91-43	75	Fail-No piece lost but some fraying.
91-44	75	Fail-No piece lost but some fraying.
91-52	75	Pass
91-53	75	Pass
91-57	75	Pass-May be very slight fraying.
91-42	-65	Fail-Small piece off rear edge.
91-45	-65	Difficult to tell because of blurring. May be small piece off rear edge.
91-46	-65	Pass
91-51	-65	Pass-Photo blurred.
91-58	-65	Pass-Photo blurred.
91-37	165	Pass-Photo blurred but may be very small piece off rear edge.
91-39	165	Pass
91-40	165	Pass-Photo blurred but may be very small piece off rear edge.
91-48	165	Pass
91-38	75	Fail-hard to tell for sure but may be very small piece off rear edge.
91-47	75	Pass
91-54	75	Pass
91-56	75	Pass

Note: First 14 specimens in table had 15° bevels on leading edge and 6° bevel on trailing edge. Last 4 specimens had no bevel on rear edge but had a 30° bevel on front edge.

applied coatings and for use in more severe environments. It was decided that the reputedly better environmental resistance of this adhesive made it worth evaluating. Two sets of Zytel 211/P104 rotating band specimens were fabricated. One was molded with fresh adhesive and passed five out of five trials in 72°F gunfire tests (see Table 6). Samples from this set also looked good in the falling dart tests exhibiting neither fracture or debonding at 72°F or -65°F. The second set was molded six weeks later with the same batch of adhesive mixed earlier. In the falling dart test, samples from this set still underwent no fracture or debonding at 72°F. The initial 72°F gunfire results from this set of samples was quite poor, three failures in three trials. Beveled leading and trailing edges were then machined onto the remaining samples from this set and they were returned to AFATL for further gunfire testing. The beveled edge samples did very well in 72°F gunfire tests, passing all five trials but the performance dropped off at -65°F and 165°F. It is certainly not inconceivable that if this system were prepared with freshly mixed adhesive and test fired with beveled edges, its performance might prove very good. Also, all of the Zytel 211-P104 specimens were prepared in a 230°F mold and use of a lower mold temperature could improve its flexibility and performance.

TABLE 6

GUNFIRE TEST RESULTS FOR ZYTEL 211/P104

Specimen Number	Test Temperature (°F)	Gunfire Results
92-11	75	Pass
92-14	75	Pass
92-18	75	Pass
92-19	75	Pass
92-20	75	Pass
92-21	75	Fail-Photo too dark to be sure but silhouette appears to indicate loss of a piece.
92-26	75	Fail-Photo too dark to be sure but looks like a small piece off front edge and some fraying at rear.
92-30	75	Fail-Photo blurred but looks like a piece is off.
92-25	75	Pass
92-29	75	Pass
92-35	75	Pass
92-39	75	Pass
92-45	75	Pass
92-22	-65	Fail-Piece off.
92-27	-65	Fail-Almost entire band lost.
92-32	-65	Pass
92-37	-65	Fail-Piece off rear half.
92-47	-65	Pass
92-23	165	Fail-Photo too dark to be sure but piece looks off.
92-28	165	Fail-Photo blurred but looks like large piece off.
92-38	165	Fail-Badly peeled.
92-43	165	Hard to tell-May be small piece off front edge.

Note: First 5 specimens made with freshly mixed adhesive and fired with 30° bevel on front edge but none on rear. Center three specimens made with adhesive mixed six weeks prior to use and fired with 30° bevel on front edge but none on rear. Last 14 specimens made with adhesive mixed six weeks prior to use but fired with 15° bevels on leading edge and 6° bevel on rear edge.

III. CONCLUSIONS

1. Although the data base from which the conclusions in this section are drawn is somewhat limited, it is felt that several material-adhesive combinations have clearly demonstrated sufficient potential to justify further and more in-depth evaluation as alternate material choices to nylon 12-253P for 20mm rotating bands.

2. The gunfire performance of the nylon 11 (BMNO)-253P system was only slightly below that of the nylon 12-253P system at 72°F. At 165°F, the nylon 11 system performed very well although at -65°F its performance was unsatisfactory. No attempts at processing optimization were undertaken in this program with the BMNO-253P system. This type of investigation combined with use of more gradual bevels on the leading and trailing edges of the rotating bands could substantially improve the performance of the BMNO system.

3. The nylon 6 (Zytel 211)-253P system, being one which is both domestically available and which has demonstrated the potential of performing well in gunfire tests at all three temperatures deserves further developmental and evaluation efforts. Its 72°F performance was excellent and its performance at -65°F and 165°F was good although photographic problems make it difficult to assess the results of all the test firings. Again no attempt at process optimization was made with this system.

4. The nylon 6 (Zytel 211)-P3 system has demonstrated considerable potential in gunfire tests and is worthy of further development and evaluation. The performance of this system at 72°F is excellent. At 165°F its performance is also very good. At -65°F it demonstrated considerable promise although its performance at this temperature was not as good as at 72°F or 165°F.

5. The nylon 6 (Zytel 211)-P104 system has also demonstrated considerable promise and should be further evaluated. Its gunfire performance at 72^oF was excellent. At -65^oF its performance was only marginal and at 165^oF it did not perform well at all. It must be remembered that the performance at these latter two temperatures was determined from specimens made with an adhesive mixed six weeks prior to use and that process optimization efforts might achieve significantly improved gunfire performance.

6. Nylon 6, 12 (Zytel 158) was tried with four adhesives (P3, P104, 253P, and FM1000). At room temperature its gunfire performance was, at best, marginal. At -65^oF the material did not perform well at all.

7. Glass filled nylon 6 (Plaskon 8231 and Plaskon 8233) was tried at glass contents ranging from 30% down to 3 1/2% (Plaskon 8231 diluted with Zytel 211) with the P3, P104, and 253P adhesives. At the 3 1/2% glass content, this combination survived falling dart tests at 72^oF and 165^oF but exhibited fracture and debonding at -65^oF. Since there is a possibility that the -65^oF falling dart test is more severe than a -65^oF gunfire test, further testing of this material should be undertaken, particularly gunfire testing.

8. Three different kinds of nylon 6, 6 were tried (Zytel 101, Zytel 42, Zytel 105) with four different adhesives (P3, P104, 253P, and FM1000). All performed poorly in the falling dart tests at room temperature, undergoing both fracture and debonding.

9. An ethylene-propylene terpolymer, designated Dexon, was tried without success. This material was reputed to bond well to steel without an adhesive and it was used in this program without an adhesive. It was found that the material simply did not bond very well to the projectiles and underwent substantial debonding in the falling dart test at room temperature.

10. A urethane band material (Texin 591A) was found to perform very well in room temperature falling dart tests but to fracture and debond in $-65^{\circ}F$ falling dart tests. The flexible nature of the material at room temperature makes its performance capabilities at $165^{\circ}F$ in a gunfire test suspect, although no actual tests at $165^{\circ}F$ have been conducted.

11. Phenylene oxide based material was tried in two forms, one a black, filled composition (SE100) and the other a gray, natural composition (ENG 265). A number of different adhesive/primer/processing parameter combinations were tried with results in falling dart tests at $72^{\circ}F$ running from poor to marginal and results in dart tests at $-65^{\circ}F$ producing consistently fractured and debonded bands.

12. Two other materials were also tried, a thermoplastic polyester (Tenite 6T-91A) and an acryllic (ST-375) with very poor falling dart performance at $72^{\circ}F$ being exhibited by both.

IV. RECOMMENDATIONS

1. Process optimization studies should be performed on the BMNO-253P, Zytel 211-P3, and Zytel 211-P104 rotating band systems to improve the gunfire performance of these 20mm rotating band systems. Although it is felt that all aspects of the fabrication process are worthy of investigation, several which have been briefly touched on in this effort, will be especially mentioned because there is reason to believe that the performance of the system could be readily improved by suitable manipulation of these specific parameters. First, use of a mold temperature lower than 230°F should be investigated to determine if a more amorphous and thereby more flexible polymer structure could be obtained. Secondly, the degree of prebaking to which the 253P, P3, and P104 adhesives are subjected prior to molding should be varied. It has been found that this can be a very significant factor and that the degree of prebaking which is optimum can vary from one band material to another.

APPENDIX A

MATERIALS UTILIZED DURING 20mm ROTATING BAND INVESTIGATION

The information listed in tables A-1 through A-4 identify not only the band materials and band adhesives evaluated in this effort, but also indicates in what combinations the various band materials and adhesives were used.

Table A-1. Rotating Band Materials Investigated

Material Designation	Type of Polymer	Source
Dexon XPA-3	ethylene-propylene-acryllic acid terpolymer	Exxon Chemical Co. Baytown, Texas
Dexon XPA-4	ethylene-propylene-acryllic acid terpolymer	Exxon Chemical Co. Baytown, Texas
Tenite 6T91A	thermoplastic polyester	Eastman Chemical Kingsport, Tenn.
XT 375	acryllic	American Cyanamid Wayne, N. J.
Texin 591A	urethane	Mobay Chemical Co. Pittsburgh, Pa.
Noryl SE100	phenylene oxide-filled, black	General Electric Selkirk, N. Y.
Noryl EN265	phenylene oxide	General Electric Selkirk, N. Y.
Rilsan BMNO	Nylon 11	Rilsan Corp. Glenrock, N. J.
Zytel 42	Nylon 6/6 (hi-viscosity)	DuPont Wilmington, Del.
Zytel 101	Nylon 6/6	DuPont Wilmington, Del.
Zytel 105	Nylon 6/6 (filled,black)	DuPont Wilmington, Del.
Zytel 158	Nylon 6/12	DuPont Wilmington, Del.
Zytel 211	Nylon 6	DuPont Wilmington, Del.

Table A-1. Rotating Band Materials Investigated (concl.)

Material Designation	Type of Polymer	Source
Polyamide L1901	Nylon 12	Mobay Chemical Co. Pittsburgh, Pa.
Plaskon 8231	Nylon 6 (14% glass filled)	Allied Chemical Morristown, N.J.
Plaskon 8233	Nylon 6 (30% glass filled)	Allied Chemical Morristown, N.J.
Plaskon 8231/ Zytel 211 [50:50]	Nylon 6 (7% glass filled)	-------
Plaskon 8231/ Zytel 211 [25:75]	Nylon 6 (3-1/2% glass filled)	-------
Plaskon 8231/ L1901 [25:75]	Nylon 6/Nylon 12 (3-1/2% glass filled)	-------

Table A-2. Adhesives Evaluated During Rotating Band Investigations

Material Designation	Type of Adhesive	Source
253P	epoxy type	M&T Chemical Co. Cincinnati, Ohio
P3	epoxy-phenolic	Rilsan Corporation Glenrock, N.J.
P104	epoxy-phenolic	Rilsan Corporation Glenrock, N.J.
Loctite 307	urethane modified acryllic	Loctite Corporation Newington, Conn.
FM53	modified epoxy	Bloomingdale Div. of American Cyanamid Havre de Grace, Md.
FM238	nitrile phenolic	Bloomingdale Div. of American Cyanamid Havre de Grace, Md.
FM1000	nylon epoxy	Bloomingdale Div. of American Cyanamid Havre de Grace, Md.
Hysol 4405/ H8L 3538	modified epoxy	Hysol New York, N.Y.
Scotchclad 776	oil resistant elastomer	3M Wayne, Mich.
Scotchweld 2214	modified epoxy (filled)	3M Wayne, Mich.
Thixon AB 1153/66	rubber based adhesive	Dayton Chemical Prod. West Alexandria, Ohio

Table A-3. Adhesive Primers Utilized During Rotating Band Studies

Material Designation	Source	Recommended For Use With
BR-1009	Bloomingdale Div. of American Cyanamid Havre de Grace, Md.	FM1000
BR-238	Bloomingdale Div. of American Cyanamid Havre de Grace, Md.	FM238
BR-53	Bloomingdale Div. of American Cyanamid Havre de Grace, Md.	FM53
Locquik T	Loctite Corporation Newington, Conn.	Loctite 307

Table A-4. Rotating Band Material/Adhesive/Primer Combinations Investigated

Comb. No.	Band Material	Adhesive	Primer
1	Dexon XPA3	None	None
2	Dexon XPA4	None	None
3	Tenite 6T-91A	Loctite 307	Lockquik T
4	XT 375	FM1000	BR 1009
5	XT 375	FM238	BR 238
6	XT 375	Scotchclad 776	None
7	XT 375	Scotchweld 2214	None
8	XT 375	Thixon AB1153/66	None
9	Texin 591A	Thixon AB1153/66	None
10	Noryl SE100	FM1000	BR 1009
11	Noryl EN265	FM1000	BR 1009
12	Noryl EN265	FM1000	BR 53
13	Noryl EN265	FM53	None
14	Noryl EN265	FM53	BR 53
15	Noryl EN265	FM53	253P
16	Noryl EN265	Hysol 4405/ H8L3538	None
17	Rilsan BMNO	253P	None
18	Rilsan BMNO	P3	None
19	Polyamide L1901	253P	None
20	Zytel 42	253P	None
21	Zytel 42	P3	None
22	Zytel 42	P104	None
23	Zytel 42	FM1000	BR 1009
24	Zytel 101	FM1000	BR 1009
25	Zytel 101	253P	None

Table A-4. Rotating Band Material/Adhesive/Primer Combinations Investigated (concl.)

Comb. No.	Band Material	Adhesive	Primer
26	Zytel 101	P3	None
27	Zytel 105	253P	None
28	Zytel 158	FM1000	BR 1009
29	Zytel 158	253P	None
30	Zytel 158	P3	None
31	Zytel 158	P104	None
32	Zytel 211	253P	None
33	Zytel 211	P3	None
34	Zytel 211	P104	None
35	Zytel 211	FM238	BR 238
36	Zytel 211	FM1000	BR 1009
37	Zytel 211	FM53U	BR 53
38	Plaskon 8233	253P	None
39	Plaskon 8233	P3	None
40	Plaskon 8233	P104	None
41	Plaskon 8231	253P	None
42	Plaskon 8231	P3	None
43	Plaskon 8231	P104	None
44	Plaskon 8231/ Zytel 211 [50:50]	253P	None
45	Plaskon 8231/ Zytel 211 [50:50]	P3	None
46	Plaskon 8231/ Zytel 211 [25:75]	253P	None
47	Plaskon 8231/ Zytel 211 [25:75]	P3	None
48	Plaskon 8231/ Zytel 211 [25:75]	P104	None
49	Plaskon 8231/ L1901 [25:75]	253P	None

APPENDIX B

MOLDING PARAMETERS AND BONDING PROCEDURES USED TO FABRICATE PLASTIC ROTATING BANDS

Forty-nine combinations of band material/adhesive/primer were fabricated and evaluated during this program. Numerous processing variations were also superimposed upon these forty-nine combinations to yield a grand total of over one hundred material/processing combinations. Each of these combinations are described in this section and the specific processing conditions and molding parameters used for each combination are also listed. Recognizing that this is a cumbersome amount of information to present and that it is highly desirable to organize it such that the time required to comprehend it is minimized, the information has been divided into two sections. The first section presents the pertinent details needed to identify each material/adhesive combination and the surface preparation and adhesive application procedures used for that particular combination. It also refers the reader to the appropriate molding parameters utilized for that combination. The second section contains copies of the injection molding data records and indicates the temperatures, pressures, times, and machine settings used to injection mold each set of specimens discussed in this report.

Each table and record sheet contains identifying sample set and specimen numbers for cross referencing with the test data presented in Appendix C and Section IIE and also designates, by name and number, the band material. It should be kept in mind that during the early months of the investigations, because of a shortage of projectiles, some were used over a second time. This lead to the same sample number occasionally appearing twice in the accompanying tables, even though the band, adhesive, or processing conditions were different for the two different occasions.

ROTATING BAND PROCESSING PARAMETER RECORD

Sheet No. P1

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
1	Dexon XPA3	None	None	None	Glass bead blast and solvent cleaned	N.A.	N.A.	M1	None	
2	Dexon XPA3	None	None	50-1 to 50-6	Glass bead blast and solvent cleaned	N.A.	N.A.	M1	None	
3	Dexon XPA3	None	None	None	Glass bead blast and solvent cleaned	N.A.	N.A.	M1	None	Only one molded before stoppage.
4	Dexon XPA3	None	None	Mixed	Glass bead blast and solvent cleaned	N.A.	N.A.	M1	Induction heated to enhance bonding	
5	Dexon XPA4	None	None	None	Glass bead blast and solvent cleaned	N.A.	N.A.	M1	None	
6	Dexon XPA4	None	None	53-1 to 53-6	Glass bead blast and solvent cleaned	N.A.	N.A.	M1	None	
7	Dexon XPA4	None	None	Mixed	Glass bead blast and solvent cleaned	N.A.	N.A.	M1	Induction heated to enhance bonding	
8	Dexon XPA4	None	None	53-11 to 53-25	Glass bead blast and solvent cleaned	N.A.	N.A.	M1	None	
9	Tenite 5T91A	Loctite 307	Locquik Primer T	60-1 to 60-6	Glass bead blast and solvent cleaned	sprayed on, excess wiped off, 20 min. air dry, re-spray, 1 hr. air dry	brushed on, 16 hr. air dry, use within 24 hr.	M2	None	
10	Noryl SE100	FM 1000	BR 1009	20-1 to 20-10	Glass bead blast and solvent cleaned	brush on, apply adhesive while still tacky	film applied, 2 hr. air dry, use within 24 hr.	M2	Cure 1 hr. at 350°F in steel sleeve	

ROTATING BAND PROCESSING PARAMETER RECORD

Sheet No. P2

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
11	Zytel 105	253P	None	65-1 to 65-6	Glass bead blast and solvent cleaned	N.A.	Dipped in undiluted 253P, shake off excess, air dry 1/2 hr.	M2	None	Sample 6[illegible]-5 induction heated to [illegible]00°F.
12	Zytel 105	253P	None	65-1 to 65-6 (reused)	Glass bead blast and solvent cleaned	N.A.	same as above but also baked 45 min. at 450°F. Adhesive diluted 50% w. MEK	M2	Induction heated	
13	Texin 591A	Thixon AB1153	None	10-1 to 10-10	Glass bead blast and solvent cleaned	N.A.	Brushed on. Air dry 1/2 - 1 hour.	M2	None	
14	Texin 591A	Thixon AB1153	None	10-11 to 10-15	Glass bead blast and solvent cleaned	N.A.	Brushed on. Air dry 1/2 - 1 hour. Baked 50 min. @ 360°F.	M2	None	
15	Texin 591A	Thixon AB1153	None	10-16 to 10-20	Glass bead blast and solvent cleaned	N.A.	Brushed on. Air dry 1/2 - 1 hour. Baked 50 min. @ 360°F.	M2	None	
16	XT 375	Thixon AB1153	None	34-1 to 34-10	Glass bead blast and solvent cleaned	N.A.	Brushed on. Air dry 1/2 - 1 hour. Baked 50 min. @ 360°F.	M9	None	
17	XT 375	Scotch. 2214	None	33-1 to 33-5	Glass bead blast and solvent cleaned	N.A.	Thin with MEK. Brush on warm. Dry 1 hour @ R.T.	M9	Cure 45 min. @ 250°F in steel sleeve	
18	XT 375	FM 1000	BR 1009	30-1 to 30-5	Glass bead blast and solvent cleaned	Brushed on. Adhesive applied while still tacky.	Apply over tacky primer. Air dry 2 hrs. Use within 24 hours.	M9	Cure 1 hr. @ 350°F in steel sleeve	
19	XT 375	FM 238	BR 238	31-1 to 31-5	Glass bead blast and solvent cleaned	Brushed on. Air dried to tackiness.	Apply on tacky primer. Dry overnight @ R.T.	M9	Cure 1 hr. @ 350°F in steel sleeve	
20	XT 375	Scotch. 776	None	32-1 to 32-5	Glass bead blast and solvent cleaned	N.A.	Brush on. Dry overnight @ R.T.	M9	None	

ROTATING BAND PROCESSING PARAMETER RECORD

Sheet No. P3

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
21	Rilsan BMNO	253P	None	80-1 to 80-6	Glass bead blast and solvent cleaned	N.A.	Dipped in undiluted 253P. Shake off excess Air dry 1/2 hr.	M3	None	
22	Rilsan BMNO	253P	None	80-1 to 80-6 (reused)	Glass bead blast and solvent cleaned	N.A.	same as above except 50% diluted with MEK and baked 45 min. at 450°F	M3	Induction heated	
23	Rilsan BMNO	253P	None	Mixed	Glass bead blast and solvent cleaned	N.A.	same as comb. #22	M3	Induction heated	
24	Rilsan BMNO	253P	None	80-11 to 80-25	Glass bead blast and solvent cleaned	N.A.	same as comb. #22	M3	Induction heated	
25	Rilsan BMNO	253P	None	80-26 to 80-35	Glass bead blast and solvent cleaned	N.A.	same as comb. #22	M3	Induction heated	
26	Rilsan BMNO	P3	None	82-1 to 82-6	Glass bead blast and solvent cleaned	N.A.	Dipped in undiluted P3. Shake off excess. Air dry 1/2 hr. Bake 10 min. at 550°F	M3	Induction heated	
27	Rilsan BMNO	P3	None	82-1 to 82-6 (reused)	Glass bead blast and solvent cleaned	N.A.	same as above except 50% diluted with MEK	M3	Induction heated	
28	L1901	253P	None	85-1 to 85-6	Glass bead blast and solvent cleaned	N.A.	same as comb. #21	M4	None	
29	L1901	253P	None	85-1 to 85-6 (reused)	Glass bead blast and solvent cleaned	N.A.	same as comb. #21 adhesive was also baked 45 min. at 450°F	M4	Induction heated	
30	L1901	253P	None	85-1 to 85-6 (reused)	Glass bead blast and solvent cleaned	N.A.	same as comb. #22	M4	Induction heated	
31	L1901	253P	None	85-7 to 85-30	Glass bead blast and solvent cleaned	N.A.	same as comb. #22	M4	Induction heated	

ROTATING BAND PROCESSING PARAMETER RECORD — Sheet No. P4

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
32	Zytel 158	FM 1000	BR 1009	70-1 to 70-6	Glass bead blast and solvent cleaned	Brushed on. Adhesive applied while still tacky	Apply over tacky primer. Air dry 2 hr. Use within 24 hr.	M5	Cure FM1000 1 hr.@ 350 F in steel sleeve.	
33	Zytel 158	253P	None	75-1 to 75-6	Glass bead blast and solvent cleaned	N.A.	same as comb. #21	M5	None	
34	Zytel 158	253P	None	75-1 to 75-6 (reused)	Glass bead blast and solvent cleaned	N.A.	same as comb. #29	M5	None	
35	Zytel 158	253P	None	75-1 to 75-6 (reused)	Glass bead blast and solvent cleaned	N.A.	same as comb. #22	M5	Induction heated	
36	Zytel 158	253P	None	Mixed	Glass bead blast and solvent cleaned	N.A.	same as comb. #22	M5	Induction heated	
37	Zytel 158	253P	None	75-11 to 75-15	Glass bead blast and solvent cleaned	N.A.	same as comb. #22	M5	Induction heated	
38	Zytel 158	253P	None	75-16 to 75-35	Glass bead blast and solvent cleaned	N.A.	same as comb. #22 except not used for 3 days	M5	Induction heated	
39	Zytel 158	253P	None	75-36 to 75-45	Glass bead blast and solvent cleaned	N.A.	same as comb. #22	M5	Induction heated	
40	Zytel 158	P104	None	77-1 to 77-10	Glass bead blast and solvent cleaned	N.A.	Mix adhesive. Let stand 24 hrs Use undiluted. Dip & shake off excess. Air dry 10 min. Bake 15 min. at 450°F.	M6	Induction heated	
41	Zytel 158	P104	None	77-1 to 77-10 (reused)	Glass bead blast and solvent cleaned	N.A.	Mix adhesive. Let stand 24 hrs Use undiluted. Dip & shake off excess. Air dry 10 min. Bake 15 min. at 450°F.	M6	Induction heated	

ROTATING BAND PROCESSING PARAMETER RECORD

Sheet No. P5

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
42	Zytel 158	P3	None	76-1 to 76-10	Glass bead blast and solvent cleaned	N. A.	Same as comb. # 26 except baken at 450°F instead of 550°F	M6	Induction heated	
43	Zytel 158	P3	None	76-11 to 76-35	Glass bead blast and solvent cleaned	N. A.	Same as comb. # 26	M6	Induction heated	
44	Zytel 158	P3	None	76-36 to 76-40	Glass bead blast and solvent cleaned	N. A.	Same as comb. # 26	M6	Induction heated	
45	Zytel 158	P3	None	76-41 to 76-60	Glass bead blast and solvent cleaned	N. A.	Same as comb. # 26 except not used for 3 days	M6	Induction heated	
46	Zytel 158	P3	None	76-61 to 76-70	Glass bead blast and solvent cleaned	N. A.	Same as comb. # 26	M6	Induction heated	

ROTATING BAND PROCESSING PARAMETER RECORD

Sheet No. F6

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
47	Zytel 101	253P	None	67-1 to 67-24	Glass bead blast and solvent cleaned	N.A.	Same as comb. #22, but not used for 5 days	M7	Induction heated	
48	Zytel 101	253P	None	67-25 to 67-44	Glass bead blast and solvent cleaned	N.A.	Same as comb. #22	M7	Induction heated	
49	Zytel 101	253P	None	67-45 to 67-49	Grit blast and solvent cleaned	N.A.	Same as comb. #22	M7	Induction heated	
50	Zytel 101	253P	None	67-50 to 67-54	Grit blast and solvent cleaned	N.A.	Same as comb. #22 except baked 1 hour at 450°F	M7	Induction heated	
51	Zytel 101	P3	None	68-1 to 68-10	Glass bead blast and solvent cleaned	N.A.	Same as comb. #26	M7	Induction heated	
52	Zytel 101	P3	None	68-11 to 68-15	Glass bead blast and solvent cleaned	N.A.	Same as comb. #26	M7	Induction heated	
53	Zytel 101	P3	None	68-16 to 68 20	Glass bead blast and solvent cleaned	N.A.	Same as comb. #26 except baked 7 min. at 550°F	M7	Induction heated	
54	Zytel 101	P3	None	68-21 to 68-25	Grit blast and solvent cleaned	N.A.	Same as comb. #52	M7	Induction heated	
55	Zytel 101	P3	None	68-26 to 68-29	Grit blast and solvent cleaned	N.A.	Same as comb. #53	M7	Induction heated	

ROTATING BAND PROCESSING PARAMETER RECORD

Sheet No. P7

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
56	Zytel 42	P3	None	41-1 to 41-10	Glass bead blast and solvent cleaned.	N.A.	Same as Comb. # 26	M8	Induction heated	
57	Zytel 42	P3	None	41-11 to 41-15	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 26 except baked 10 min. @ 525°F instead of 550°F.	M8	Induction heated	
58	Zytel 42	P104	None	42-1 to 42-10	Glass bead blast and solvent cleaned.	N.A.	Same as Comb. # 40	M8	Induction heated	
59	Zytel 42	P104	None	42-11 to 42-15	Glass bead blast and solvent cleaned.	N.A.	Same as comb. #40 except baked 15 min. @ 475°F instead of 450°F.	M8	Induction heated	
60	Zytel 42	253P	None	40-1 to 40-10	Glass bead blast and solvent cleaned.	N.A.	Same as Comb. # 22	M8	Induction heated	
61	Zytel 42	253P	None	40-11 to 40-15	Glass bead blast and solvent cleaned.	N.A.	Same as comb. #22 except baked 45 min. @ 425°F instead of 450°F.	M8	Induction heated	
62	Zytel 42	FM 1000	BR 1009	43-1 to 43-5	Glass bead blast and solvent cleaned.	N.A.	Same as Comb. #10	M8	Same as Comb. #10	

ROTATING BAND PROCESSING PARAMETER RECORD

Sheet No. P8

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
63	Zytel 211	253P	None	90-1 to 90-10	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 22	M10	Induction heated	
64	Zytel 211	253P	None	90-11 to 90-35	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 22	M10	Induction heated	
65	Zytel 211	253P	None	90-36 to 90-60	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 61	M10	Induction heated	
66	Zytel 211	253P	None	90-61 to 90-85	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 22	M11	Induction heated	Some had bevels machined on edges before gunfire.
67	Zytel 211	P3	None	91-1 to 91-10	Glass bead blast and solvent cleaned.	N.A.	Same as comb. #26 except baked 45 min. @ 450 °F instead of 10 min. @ 550°F.	M10	Induction heated	
68	Zytel 211	P3	None	91-11 to 91-35	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 67	M10	Induction heated	
69	Zytel 211	P3	None	91-36 to 91-60	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 26 except air dried 1 hr. instead of 1/2 hr.	M10	Induction heated	Some had bevels machined on edges before gunfire.
70	Zytel 211	P104	None	92-1 to 92-10	Glass bead blast and solvent cleaned.	N.A.	Mix adhesive. Let stand 24 hrs. Use undiluted. Dip & shake off excess. Air dry 10 min.	M10	Induction heated	
71	Zytel 211	P104	None	92-11 to 92-20	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 70 except also baked 15 min. @ 450°F before molding.	M10	Induction heated	
72	Zytel 211	P104	None	92-21 to 92-45	Glass bead blast and solvent cleaned.	N.A.	Same as comb. #71 except adhesive mixed 6 weeks prior to use.	M11	Induction heated	
73	Zytel 211	P104	None	92-46 to 92-57	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 71	M11	Induction heated	

ROTATING BAND PROCESSING PARAMETER RECORD — Sheet No. P9

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
74	Zytel 211	FM 238	BR 238	93-1 to 93-5	Grit blast and solvent cleaned.	Brushed on and allowed to air dry to tackiness.	Adhesive film applied to tacky primer. Allowed to dry overnight @ R. T.	M11	Adhesive cured 1 hr. @ 350°F in steel sleeve	
75	Zytel 211	FM 1000	BR 1009	94-1 to 94-5	Grit blast and solvent cleaned.	Brushed on and allowed to air dry to tackiness.	Adhesive film applied to tacky primer. Air dried 2 hours.	M11	Adhesive cured 1 hr. @ 350°F in steel sleeve	
76	Zytel 211	FM 53U	BR 53	95-1 to 95-5	Grit blast and solvent cleaned.	Brushed on and allowed to air dry 1/2 hour.	Adhesive film applied to dry primer.	M11	Adhesive cured 1 hr. @ 350°F in steel sleeve	
77	Zytel 101	FM 1000	BR 1009	69-1 to 69-10	Glass bead blast and solvent cleaned.	Same as Comb. # 75	Same as comb. # 75	M7	Adhesive cured 1 hr. @ 350°F in steel sleeve	Adhesive cured 5 days after molding.
78	Zytel 101	FM 1000	BR 1009	69-11 to 69-15	Glass bead blast and solvent cleaned.	Same as comb. # 75	Same as comb. # 75	M7	Adhesive cured 1 hr. @ 350°F in steel sleeve	Adhesive cured 2 days after molding.
79	Zytel 101	FM 1000	BR 1009	69-16 to 69-20	Glass bead blast and solvent cleaned.	Same as comb. # 75	Same as comb. # 75	M7	Adhesive cured 1 hr. @ 350°F in steel sleeve	Adhesive cured 1 day after molding.
80	Zytel 101	FM 1000	BR 1009	69-21 to 69-25	Glass bead blast and solvent cleaned.	Same as comb. # 75	Same as comb. # 75	M7	Adhesive cured 2 hr. @ 350°F in steel sleeve	Adhesive cured 2 days after molding.

ROTATING BAND PROCESSING PARAMETER RECORD

Sheet No. P10

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
81	Noryl EN265	FM 53U	253P	21-1 to 21-3	Glass bead blasted and solvent cleaned	Dipped in undiluted MEK. Shake off excess. Air dry 1/2 hr. Bake 45 min. at 450°F.	Adhesive film applied over dry primer	M12	Adhesive cured 16 hr at 175°F	Cure pressure provided by shrink tape
82	Noryl EN265	FM 53U	253P	21-4 to 21-6	Glass bead blasted and solvent cleaned	Dipped in undiluted MEK. Shake off excess. Air dry 1/2 hr. Bake 45 min. at 450°F.	Adhesive film applied over dry primer	M12	Adhesive cured 1-1/2 hr at 250°F	Cure pressure provided by shrink tape
83	Noryl EN265	FM 53U	None	21-7 to 21-9	Glass bead blasted and solvent cleaned	N.A.	Adhesive film applied directly onto projectile surface.	M12	Adhesive cured 16 hr at 175°F	Cure pressure provided by shrink tape
84	Noryl EN265	FM 53U	None	21-10 to 21-12	Glass bead blasted and solvent cleaned	N.A.	Adhesive film applied directly onto projectile surface.	M12	Adhesive cured 1-1/2 hr at 250°F	Cure pressure provided by shrink tape
85	Noryl EN265	FM 53U	BR 53	21-13 to 21-15	Glass bead blasted and solvent cleaned	Brush on. Air dry 1/2 hr. at R.T.	Same as combination No. 81	M12	Adhesive cured 16 hr at 175°F	Cure pressure provided by shrink tape
86	Noryl EN265	FM 53U	BR 53	21-16 to 21-18	Glass bead blasted and solvent cleaned	Brush on. Air dry 1/2 hr. at R.T.	Same as combination No. 81	M12	Adhesive cured 1-1/2 hr at 250°F	Cure pressure provided by shrink tape
87	Noryl EN265	FM53 MEK	253P	21-19 & 21-20	Glass bead blasted and solvent cleaned	Same as combination No. 81	Dissolve FM53U film in MEK. Brush on. Air dry 1 hr. at R.T.	M12	Same as combination No. 81	Cure pressure provided by shrink tape
88	Noryl EN265	FM53 MEK	253P	21-21 & 21-22	Glass bead blasted and solvent cleaned	Same as combination No. 81	Dissolve FM53U film in MEK. Brush on. Air dry 1 hr. at R.T.	M12	Same as combination No. 82	Cure pressure provided by shrink tape
89	Noryl EN265	FM53 MEK	None	21-23 & 21-24	Glass bead blasted and solvent cleaned	N.A.	Dissolve FM53U film in MEK. Brush on. Air dry 1 hr. at R.T.	M12	Same as combination No. 81	Cure pressure provided by shrink tape
90	Noryl EN265	FM53 MEK	None	21-25 & 21-26	Glass bead blasted and solvent cleaned	N.A.	Dissolve FM53U film in MEK. Brush on. Air dry 1 hr. at R.T.	M12	Same as combination No. 82	Cure pressure provided by shrink tape
91	Noryl EN265	FM53 MEK	BR 53	21-27 & 21-28	Glass bead blasted and solvent cleaned	Same as combination No. 85	Dissolve FM53U film in MEK. Brush on. Air dry 1 hr. at R.T.	M12	Same as combination No. 81	Cure pressure provided by shrink tape
92	Noryl EN265	FM53 MEK	BR 53	21-29 & 21-30	Glass bead blasted and solvent cleaned	Same as combination No. 85	Dissolve FM53U film in MEK. Brush on. Air dry 1 hr. at R.T.	M12	Same as combination No. 82	Cure pressure provided by shrink tape

ROTATING BAND PROCESSING PARAMETER RECORD — Sheet No. P11

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
93	Noryl EN265	FM 53U	None	21-31 & 21-32	Glass bead blasted and solvent cleaned	N.A.	Same as combination No. 83 but also pre-cured 6 hr. at 175°F	M12	Cured 1-1/2 hr at 250°F in shrink tape	
94	Noryl EN265	FM 53U	None	21-33 & 21-34	Glass bead blasted and solvent cleaned	N.A.	Same as combination No. 83 but also pre-cured 5 hr. at 175°F	M12	Cured 1-1/2 hr at 250°F in shrink tape	
95	Noryl EN265	FM 53U	None	21-35 & 21-36	Glass bead blasted and solvent cleaned	N.A.	Same as combination No. 83 but also pre-cured 4 hr. at 175°F	M12	Cured 1-1/2 hr at 250°F in shrink tape	
96	Noryl EN265	FM 53U	None	21-37 & 21-38	Glass bead blasted and solvent cleaned	N.A.	Same as combination No. 83 but also pre-cured 3 hr. at 175°F	M12	Cured 1-1/2 hr at 250°F in shrink tape	
97	Noryl EN265	FM 53U	None	21-39 & 21-40	Glass bead blasted and solvent cleaned	N.A.	Same as combination No. 83 but also pre-baked 2 hr. at 175°F	M12	Cured 1-1/2 hr at 250°F in shrink tape	
98	Noryl EN265	FM 53U	None	21-41 & 21-42	Glass bead blasted and solvent cleaned	N.A.	Same as combination No. 83 but also pre-baked 10 hr. at 175°F	M12	Cured 1-1/2 hr at 250°F in shrink tape	
99	Noryl EN265	Hysol 4405	None	22-1 & 22-2	Glass bead blasted and solvent cleaned	N.A.	Parts A&B mixed. Brushed on. Air dried 30 min. at R.T. and 2 min. at 200°F.	M12	Cured 1-1/2 hr at 150°F in shrink tape	
100	Noryl EN265	Hysol 4405	None	22-3 & 22-4	Glass bead blasted and solvent cleaned	N.A.	Parts A&B mixed. Brushed on. Air dried 45 min. at R.T. and 2 min. at 200°F	M12	Cured 1-1/2 hr at 150°F in shrink tape	
101	Noryl EN265	Hysol 4405	None	22-5 & 22-6	Glass bead blasted and solvent cleaned	N.A.	Parts A&B mixed. Brushed on. Air dried 60 min. at R.T. and 2 min. at 200°F.	M12	Cured 1-1/2 hr at 150°F in shrink tape	
102	Noryl EN265	Hysol 4405	None	22-7 & 22-8	Glass bead blasted and solvent cleaned	N.A.	Parts A&B mixed. Brushed on. Air dried 75 min. at R.T. and 2 min. at 200°F.	M12	Cured 1-1/2 hr at 150°F in shrink tape	
103	Noryl EN265	Hysol 4405	None	22-9 & 22-10	Glass bead blasted and solvent cleaned	N.A.	Parts A&B mixed. Brushed on. Air dried 90 min. at R.T. and 2 min. at 200°F.	M12	Cured 1-1/2 hr at 150°F in shrink tape	

ROTATING BAND PROCESSING PARAMETER RECORD — Sheet No. P12

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
104	Noryl EN265	FM 1000	BR 53	23-1 to 23-4	Grit blast. solvent clean.	Brush on. Air dry 1/2 hr.	Apply onto dry primer.	M13	Adhesive cured 1 hr at 350°F in steel sleeve	
105	Noryl EN265	FM 1000	BR 53	23-5 & 23-6	Grit blast. solvent clean.	Brush on. Air dry 1/2 hr.	Apply onto dry primer.	M13	Adhesive cured 1 hr at 350°F in steel sleeve	
106	Noryl EN265	FM 1000	BR 53	23-7 & 23-8	Grit blast. solvent clean.	Brush on. Air dry 1/2 hr.	Apply onto dry primer.	M13	Adhesive cured 1 hr at 350°F in steel sleeve	
107	Noryl EN265	FM 1000	BR 53	23-9 to 23-12	Solvent clean. Acid etch. Water rinse. Alcohol rinse. Dry.	Brush on. Air dry 1/2 hr.	Apply onto dry primer.	M13	Adhesive cured 1 hr at 350°F in steel sleeve	
108	Noryl EN265	FM 1000	BR 53	23-13 & 23-14	Solvent clean. Acid etch. Water rinse. Alcohol rinse. Dry.	Brush on. Air dry 1/2 hr.	Apply onto dry primer.	M13	Adhesive cured 1 hr at 350°F in steel sleeve	
109	Noryl EN265	FM 1000	BR 53	23-15 & 23-16	Solvent clean. Acid etch. Water rinse. Alcohol rinse. Dry.	Brush on. Air dry 1/2 hr.	Apply onto dry primer.	M13	Adhesive cured 1 hr at 350°F in steel sleeve	
110	Noryl EN265	FM 1000	BR 1009	24-1 to 24-5	Glass bead blasted. Solvent cleaned.	Same as combination No. 10	Same as combination No. 10	M13	Adhesive cured 1 hr at 350°F in steel sleeve	
111	Noryl EN265	FM 1000	BR 1009	24-6 & 24-7	Glass bead blasted. Solvent cleaned.	Same as combination No. 10	Same as combination No. 10	M13	Cured 1-1/2 hr at 300°F in steel sleeve	
112	Noryl EN265	FM 1000	BR 1009	24-8 & 24-9	Glass bead blasted. Solvent cleaned.	Same as combination No. 10	Same as combination No. 10	M13	Cured 2 hr at 250°F in steel sleeve	
113	Noryl EN265	FM 1000	BR 1009	24-10 to 24-12	Glass bead blasted. Solvent cleaned.	Brush on. Dry 1-1/2 hr at 175°F. No longer tacky.	Same as combination No. 10	M13	Cured 1-1/2 hr at 300°F in steel sleeve	
114	Noryl EN265	FM 1000	BR 1009	24-13 to 24-15	Glass bead blasted. Solvent cleaned.	Brush on. Dry 1-1/2 hr at 175°F. No longer tacky.	Same as combination No. 10	M13	Cured 2 hr at 250°F in steel sleeve	

ROTATING BAND PROCESSING PARAMETER RECORD

Sheet No. P13

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
115	Plaskon 8231	253P	None	100-1 to 100-6	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 22	M14	Induction heated	14% glass
116	Plaskon 8231	P3	None	101-1 to 101-6	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 27	M14	Induction heated	14% glass
117	Plaskon 8231	P104	None	102-1 to 102-6	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 40 except baked 25 min. @ 450°F instead of 15 min.	M14	Induction heated	14% glass
118	Plaskon 8233	253P	None	110-1 to 110-6	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 22	M14	Induction heated	30% glass
119	Plaskon 8233	P3	None	111-1 to 111-6	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 27	M14	Induction heated	30% glass
120	Plaskon 8233	P104	None	112-1 to 112-6	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 117	M14	Induction heated	30% glass
121	P. 8231 / Z. 211	253P	None	120-1 to 120-5	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 22	M15	Induction heated	7% glass
122	P. 8231 / Z. 211	253P	None	120-6 to 120-10	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 22 except diluted to 25% in MEK instead of 50%.	M15	Induction heated	7% glass
123	P. 8231 / Z. 211	253P	None	130-1 to 130-5	Glass bead blast and solvent cleaned.	N.A.	Same as comb. # 22	M15	Induction heated	3 1/2% glass

ROTATING BAND PROCESSING PARAMETER RECORD

Sheet No. P14

Combination Number	Resin	Adhesive	Primer	Sample Numbers	Projectile Surface Preparation	Primer Application Procedure	Adhesive Application Procedure	Location of Molding Data	Post-Molding Treatment	Remarks
124	P. 8231 / Z. 211	P3	None	121-1 to 121-5	Glass bead blast and solvent cleaned.	N. A.	Same as comb. # 27	M15	Induction heated	7% glass
125	P. 8231 / Z. 211	P3	None	121-6 to 121-10	Glass bead blast and solvent cleaned.	N. A.	Same as comb. # 27 except diluted to 25% in MEK instead of 50%.	M15	Induction heated	7% glass
126	P. 8231 / Z. 211	P3	None	131-1 to 131-5	Glass bead blast and solvent cleaned.	N. A.	Same as comb. # 27	M15	Induction heated	3 1/2% glass
127	P. 8231 / Z. 211	P104	None	132-1 to 132-5	Glass bead blast and solvent cleaned.	N. A.	Same as comb. # 40	M15	Induction heated	3 1/2% glass
128	P. 8231 / L1901	253P	None	135-1 to 135-3	Glass bead blast and solvent cleaned.	N. A.	Same as comb. # 22	M15	Induction heated	3 1/2% glass
129	P. 8231 / L1901	253P	None	135-4 to 135-6	Solvent cleaned only.	N. A.	Same as comb. # 22	M15	Induction heated	3 1/2% glass
130	P. 8231 / L1901	253P	None	135-7 to 135-9	Glass bead blast and solvent cleaned.	N. A.	Same as comb. # 22	M15	Induction heated	3 1/2% glass
131	P. 8231 / L1901	253P	None	135-10 to 135-12	Solvent cleaned only.	N. A.	Same as comb. # 22	M15	Induction heated	3 1/2% glass

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS																		Sheet No. M1		
Job Operator: D. Pike			Mold Description: Rotating Band								Barrel/ Screw: Standard						Safety Check Engineer: D. R. Askins			
Molding Date	Resin	Adhesive	Comment Code	Temperature (°F)			Mold		Press.(psi)		Cycle Times(sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)
				Nozzle	Front	Rear	Fixed	Movable	Injection	Back	Injection	Open	Overall	Ram in Motion	Knob Setting	RPM			
3-4-74	Dexon XPA-3	None	1	475	450	400	75	75	500	125	16	55	120	2-3	B-5.0	160	1/8	Green 0	1-3/16
3-22-74	Dexon XPA-3	None	2	475	450	400	260	260	500	125	16	55	120	2-3	B-5.0	160	1/8	Green 0	1-3/16
5-29-74	Dexon XPA-3	None	3	475	450	400	350	350	500	125	16	55	120	2-3	B-5.0	160	1/8	Green 0	1-3/16
7-2-74	Dexon XPA-3	None	4	475	450	400	180	180	500	125	16	55	120	2-3	B-5.0	160	1/8	Green 0	1-3/16
3-4-74	Dexon XPA-4	None	1	475	450	400	75	75	500	125	16	55	120	2-3	B-5.0	160	1/8	Green 0	1-3/16
3-22-74	Dexon XPA-4	None	5	475	450	450	260	260	500	125	16	55	120	2-3	B-5.0	160	1/8	Green 0	1-3/16
7-2-74	Dexon XPA-4	None	4	475	450	450	180	180	500	125	16	55	120	2-3	B-5.0	160	1/8	Green 0	1-3/16
9-20-74	Dexon XPA-4	None	6	475	450	450	200	200	500	125	16	55	120	2-3	B-5.0	160	1/16	Green 0	1-3/16

Comments:
1. Three unnumbered samples.
2. Sample Nos. 50-1 to 50-6. Projectiles preheated to 350°F before being placed in mold.
3. One sample molded. Resin stuck to mold passages at this temperature and prevented further molding.
4. Seven samples. Abnormal numbering due to reuse of projectiles.
5. Sample Nos. 53-1 to 53-6. Projectiles preheated to 350°F before being placed in mold.
6. Sample Nos. 53-11 to 53-25. Projectiles preheated to 500°F before being placed in mold.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS																			Sheet No. M2	
Job Operator D. Pike			Mold Description Rotating Band							Barrel/ Screw Standard							Safety Check Engineer D. R. Askins			
Molding Date	Resin	Adhe-sive	Comment Code	Temperature (°F)					Press.(psi)		Cycle Times(sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)	
				Nozzle	Front	Rear	Mold Fixed	Mold Mov-able	Injec-tion	Back	Injec-tion	Open	Overall	Ram in Motion	Knob Setting	RPM				
3-6-74	Tenite 5T91-A	L. 307 Loc. I	1	525	500	475	95	95	700	75	26	55	120	2-3	B-7.5	110	1/8	Green 8	1-3/16	
3-6-74	Zytel 105	253P	2	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	400	1/8	Green 8	1-3/16	
5-31-74	Zytel 105	253P	2	570	540	540	270	290	650	125	16	55	120	2-3	B-0.0	400	1/8	Green 8	1-3/16	
11-8-74	Noryl SE100	EM1000 ER1007	3	550	525	500	180	180	700	125	26	55	120	2-4	B-6.0	---	5/16	Green 3	1-1/4	
1-8-75	Texin 591A	Thix. AB1153	4	440	450	440	130	130	600	125	26	55	120	2-3	B-6.0	---	1/16	Green 7	1-1/16	

Comments:
1. Resin dried 1-1/2 hr. at 180°F. Sample Nos. 60-1 to 60-6.
2. Resin dried 2 hr. at 200°F. Sample Nos. 65-1 to 65-6.
3. Resin dried 2 hr. at 220°F. Sample Nos. 20-1 to 20-10.
4. Resin dried 3 hr. at 220°F. Sample Nos. 10-1 to 10-20. These twenty subdivided into three groups of ten, five and five. Samples 10-1 to 10-10 molded with no adhesive pre-bake. Samples 10-11 to 10-20 had prebaked adhesive. Samples 10-11 to 10-15 were cold when placed in mold. Samples 10-16 to 10-20 were hot when placed in mold.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS | Sheet No. M3

Job Operator	Mold Description	Barrel/ Screw	Safety Check Engineer
D. Pike	Rotating Band	Standard	D. R. Askins

Molding Date	Resin	Adhesive	Comment Code	Temperature (°F)					Press.(psi)		Cycle Times(sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)
				Nozzle	Front	Rear	Mold Fixed	Mold Movable	Injection	Back	Injection	Open	Overall	Ram in Motion	Knob Setting	RPM			
4-18-74	Rilsan BMNO	253P	1	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	400	1/16	Green 8	1-3/16
4-18-74	Rilsan BMNO	P3	2	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	400	1/16	Green 8	1-3/16
5-31-74	Rilsan BMNO	P3	3	570	540	540	270	290	650	125	16	55	120	2-3	B-0.0	400	1/16	Green 8	1-3/16
5-31-74	Rilsan BMNO	253P	4	570	540	540	270	290	650	125	16	55	120	2-3	B-0.0	400	1/16	Green 8	1-3/16
6-17-74	Rilsan BMNO	253P	5	570	540	540	270	290	650	125	16	55	120	2-3	B-0.0	400	1/16	Green 8	1-3/16
7-16-74	Rilsan BMNO	253P	6	570	540	540	280	280	650	125	16	55	120	2-3	B-0.0	---	1/16	Green 8	1-3/16
8-14-74	Rilsan BMNO	253P	7	570	540	540	280	280	650	125	16	55	120	2-3	B-0.0	---	1/16	Green 8	1-3/16

Comments:
1. Resin dried 3 hr. at 200°F. Sample Nos. 80-1 to 80-6.
2. Resin dried 3 hr. at 200°F. Sample Nos. 82-1 to 82-6.
3. Resin dried 2 hr. at 200°F. Sample Nos. 82-1 to 82-6(reused).
4. Resin dried 2 hr. at 200°F. Sample Nos. 80-1 to 80-6(reused).
5. Resin dried 2 hr. at 200°F. Twelve samples. Abnormal numbering due to reuse of projectiles
6. Resin dried 2 hr. at 200°F. Sample Nos. 80-11 to 80-25.
7. Resin dried 2 hr. at 200°F. Sample Nos. 80-26 to 80-35. Molding machine had broken poppett for this run.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS																		Sheet No. M4		
Job Operator D. Pike			Mold Description Rotating Band							Barrel/Screw Standard						Safety Check Engineer D. R. Askins				
Molding Date	Resin	Adhesive	Comment Code	Temperature (°F)					Press.(psi)		Cycle Times(sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)
				Nozzle	Front	Rear	Mold Fixed	Mold Movable	Injection	Back	Injection	Open	Overall	Ram in Motion	Knob Setting	RPM			
3-5-74	L1901	253P	1	575	500	475	175	175	600	125	26	55	180	2	B-7.5	160	1/8	Green 0	1-3/16
4-25-74	L1901	253P	2	575	500	475	175	175	600	125	26	55	180	2	B-7.5	160	1/8	Green 0	1-3/16
5-30-74	L1901	253P	3	575	500	475	280	280	600	125	26	55	180	2	B-7.5	160	1/8	Green 0	1-3/16
7-15-74	L1901	253P	4	575	500	475	270	290	600	125	26	55	180	2-3	B-7.5	160	1/8	Green 0	1-3/16

Comments:
1. Resin dried 2 hr. at 200°F. Sample Nos. 85-1 to 85-6.
2. Resin dried 2 hr. at 200°F. Sample Nos. 85-1 to 85-6(reused).
3. Resin dried 2 hr. at 200°F. Sample Nos. 85-1 to 85-6(reused again).
4. Resin dried 2 hr. at 200°F. Sample Nos. 85-7 to 85-30.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS																		Sheet No. M5		
Job Operator D. Pike			Mold Description Rotating Band								Barrel/ Screw Standard						Safety Check Engineer D. R. Askins			
Molding Date	Resin	Adhesive	Comment Code	Temperature (°F)					Press.(psi)		Cycle Times(sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)
				Nozzle	Front	Rear	Mold Fixed	Mold Movable	Injection	Back	Injection	Open	Overall	Ram in Motion	Knob Setting	RPM			
3-6-74	Zytel 158	FM1000 / BR1009	1	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	400	1/8	Green 8	1-3/16
3-6-74	Zytel 158	253P	2	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	400	1/8	Green 8	1-3/16
4-18-74	Zytel 158	253P	3	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	400	1/8	Green 8	1-3/16
5-31-74	Zytel 158	253P	4	570	540	540	270	290	650	125	16	55	120	2-3	B-0.0	400	1/8	Green 8	1-3/16
6-17-74	Zytel 158	253P	5	570	540	540	270	290	650	125	16	55	120	2-3	B-0.0	400	1/8	Green 8	1-3/16
10-11-74	Zytel 158	253P	6	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	400	1/8	Green 8	1-3/16
1-23-75	Zytel 158	253P	7	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	150	1/16	Green 8	1-1/8

Comments: Resin dried 3 hr. at 200°F for all of above operations.

1. Samples 70-1 to 70-6.
2. Samples 75-1 to 75-6.
3. Samples 75-1 to 75-6(reused).
4. Samples 75-1 to 75-6(reused again).
5. Eleven samples. Numbering was abnormal due to reuse of previous specimens.
6. Samples 75-11 to 75-15.
7. Samples 75-16 to 75-45. First twenty molded three days after application of 253P. Last ten molded same day as 253P application.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS																		Sheet No. M6		
Job Operator D. Pike			Mold Description Rotating Band								Barrel/Screw Standard						Safety Check Engineer D. R. Askins		
Molding Date	Resin	Adhesive	Comment Code	Temperature (°F)					Press.(psi)		Cycle Times(sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)
				Nozzle	Front	Rear	Mold Fixed	Mold Movable	Injection	Back	Injection	Open	Overall	Ram in Motion	Knob Setting	RPM			
8-21-74	Zytel 158	P3	1	570	540	540	280	280	650	125	16	55	120	2-3	B-0.0	---	1/8	Green 8	1-3/16
9-6-74	Zytel 158	P104	2	570	540	540	280	280	650	125	16	55	120	2-3	B-0.0	---	1/8	Green 8	1-3/16
9-6-74	Zytel 158	P3	3	570	540	540	280	280	650	125	16	55	120	2-3	B-0.0	---	1/8	Green 8	1-3/16
10-11-74	Zytel 158	P3	4	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	---	1/8	Green 8	1-3/16
10-31-74	Zytel 158	P104	5	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	---	1/8	Green 8	1-3/16
1-23-75	Zytel 158	P3	6	570	540	540	160	160	650	125	16	55	120	2-3	B-0.0	150	1/8	Green 8	1-3/16

Comments: Resin dried 3 hr. at 200°F for all of above operations.

1. Samples 76-1 to 76-10.
2. Samples 77-1 to 77-10. Adhesive was mixed 6 weeks prior to use.
3. Samples 76-11 to 76-35.
4. Samples 76-36 to 76-40.
5. Samples 77-1 to 77-10(reused). Freshly mixed adhesive.
6. Samples 76-41 to 76-70. First twenty molded three days after application of P3. Last ten molded same day as P3 application.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS																		Sheet No. M7	
Job Operator: D. Pike				Mold Description: Rotating Band						Barrel/Screw: Standard						Safety Check Engineer: D. R. Askins			
Molding Date	Resin	Adhesive	Comment Code	Temperature (°F)					Press. (psi)		Cycle Times (sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)
				Nozzle	Front	Rear	Mold Fixed	Mold Movable	Injection	Back	Injection	Open	Overall	Ram in Motion	Knob Setting	RPM			
8-8-74	Zytel 101	253P	1	600	600	600	230	230	500	125	16	55	120	2-3	B-0.0	---	1/8	Green 2	1-1/4
8-13-74	Zytel 101	253P	2	600	580	600	230	230	500	125	16	55	120	2-3	B-0.0	---	1/8	Green 2	1-1/4
8-21-74	Zytel 101	P3	3	600	580	600	230	230	500	125	16	55	120	2-3	B-0.0	---	1/8	Green 2	1-1/4
9-23-74	Zytel 101	253P	4	600	600	600	160	160	500	125	16	55	120	2-3	B-0.0	---	1/8	Green 2	1-1/4
9-24-74	Zytel 101	P3	5	600	600	600	160	160	500	125	16	55	120	2-3	B-0.0	---	1/8	Green 2	1-1/4
10-2-74	Zytel 101	FM1000 BR1009	6	600	600	600	160	160	500	125	16	55	120	2-3	B-0.0	---	1/8	Green 2	1-1/8

Comments: All resin dried 2 hr. at 200°F in above operations.

1. Run terminated prematurely due to barrel malfunction.
2. Samples 67-1 to 67-24. Adhesive applied five days prior to molding. Machine had broken poppett.
3. Samples 68-1 to 68-10. Broken poppett on machine.
4. Samples 67-25 to 67-44.
5. Samples 68-11 to 68-29. These samples subdivided into four groups for various surface preparation and adhesive cure cycle studies.
6. Samples 69-1 to 69-25. These samples subdivided into four groups for study of various cure cycles.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS																			Sheet No. M8
Job Operator D. Pike			Mold Description Rotating Band							Barrel/ Screw Standard						Safety Check Engineer D. R. Askins			
Molding Date	Resin	Adhesive	Comment Code	Temperature (°F)					Press.(psi)		Cycle Times(sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting Screw color)	Total Feed Setting (inch)
				Nozzle	Front	Rear	Mold Fixed	Mold Movable	Injection	Back	Injection	Open	Overall	Ram in Motion	Knob Setting	RPM			
9-10-74	Zytel 42	P104	1	590	540	580	230	230	700	125	16	55	120	4	B-0.0	---	1/8	Green 6	1-1/4
9-10-74	Zytel 42	253P	2	590	540	580	230	230	700	125	16	55	120	4	B-0.0	---	1/8	Green 6	1-1/4
9-10-74	Zytel 42	P3	3	590	540	580	230	230	700	125	16	55	120	4	B-0.0	---	1/8	Green 6	1-1/4
10-10-74	Zytel 42	P104	4	590	540	580	230	230	700	125	16	55	120	4	B-0.0	---	1/8	Green 6	1-1/4
10-10-74	Zytel 42	253P	5	590	540	580	230	230	700	125	16	55	120	4	B-0.0	---	1/8	Green 6	1-1/4
10-10-74	Zytel 42	P3	6	590	540	580	230	230	700	125	16	55	120	4	B-0.0	---	1/8	Green 6	1-1/4
10-10-74	Zytel 42	CM1000 BR1009	7	590	540	580	230	230	700	125	16	55	120	4	B-0.0	---	1/8	Green 6	1-1/4

Comments: All resin dried 3 hr. at 175°F in above operations

1. Samples 42-1 to 42-10. Adhesive mixed two weeks prior to use.
2. Samples 40-1 to 40-10.
3. Samples 41-1 to 41-10.
4. Samples 42-11 to 42-15. Adhesive mixed two weeks prior to use.
5. Samples 40-11 to 40-15.
6. Samples 41-11 to 41-15.
7. Samples 43-1 to 43-5.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS																		Sheet No. M9		
Job Operator D. Pike			Mold Description Rotating Band							Barrel/Screw Standard								Safety Check Engineer D. R. Askins		
Molding Date	Resin	Adhesive	Comment Code	Temperature (°F)					Press.(psi)		Cycle Times(sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)
				Nozzle	Front	Rear	Mold Fixed	Mold Movable	Injection	Back	Injection	Open	Overall	Ram in Motion	Knob Setting	RPM			
11-18-74	XT-375	Thix. AB1153	1	525	475	375	130	130	700	125	16	55	120	2	B-7.0	---	1/8	Green 1	1-1/4
11-20-74	XT-375	Scot. 2214	2	525	475	375	130	130	700	125	16	55	120	2	B-7.0	---	1/8	Green 1	1-1/4
11-20-74	XT-375	FM1000 / BR1009	3	525	475	375	130	130	700	125	16	55	120	2	B-7.0	---	1/8	Green 1	1-1/4
11-20-74	XT-375	[illegible]123 / BR238	4	525	475	375	130	130	700	125	16	55	120	2	B-7.0	---	1/8	Green 1	1-1/4
11-20-74	XT-375	Scot. 776	5	525	475	375	130	130	700	125	16	55	120	2	B-7.0	---	1/8	Green 1	1-1/4

Comments: All resin dried 4 hrs. at 180°F in above operations.

1. Samples 34-1 to 34-10. Adhesive applied five days prior to molding.
2. Samples 33-1 to 33-5.
3. Samples 30-1 to 30-5.
4. Samples 31-1 to 31-5.
5. Samples 32-1 to 32-5.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS

Sheet No. M10

Job Operator: D. Pike

Mold Description: Rotating Band

Barrel/Screw: Standard

Safety Check Engineer: D. R. Askins

Molding Date	Resin	Adhesive	Comment Code	Temperature (°F) Nozzle	Front	Rear	Mold Fixed	Mold Movable	Press. (psi) Injection	Back	Cycle Times (sec.) Injection	Open	Overall	Ram in Motion	Screw Speed Knob Setting	RPM	Cushion (inch)	Feed Rate Setting Screw color	Total Feed Setting (inch)
7-30-74	Zytel 211	253P	1	500	500	500	230	230	550	125	16	55	120	2-3	3-0.0	---	1/8	Green 2	1-1/4
7-30-74	Zytel 211	253P	2	500	500	500	230	230	550	125	16	55	120	2-3	3-0.0	---	1/8	Green 2	1-1/4
8-21-74	Zytel 211	P3	3	500	500	500	230	230	550	125	16	55	120	2-3	3-0.0	---	1/8	Green 2	1-1/4
8-29-74	Zytel 211	P104	4	500	500	500	230	230	550	125	16	55	120	2-3	3-0.0	---	1/8	Green 2	1-1/4
9-4-74	Zytel 211	253P	5	500	500	500	230	230	550	125	16	55	120	2-3	3-0.0	---	1/8	Green 2	1-1/4
9-4-74	Zytel 211	P3	6	500	500	500	230	230	550	125	16	55	120	2-3	3-0.0	---	1/8	Green 2	1-1/4
9-5-74	Zytel 211	P3	7	500	500	500	230	230	550	125	16	55	120	2-3	3-0.0	---	1/8	Green 2	1-1/4

Comments: All resin dried 2 hrs. at 200°F in above operations.

1. Samples 90-1 to 90-10. Adhesive applied one week prior to molding. Machine had broken poppett.
2. Samples 90-11 to 90-35. Machine had broken poppett.
3. Samples 91-1 to 91-10. Machine had broken poppett.
4. Samples 92-1 to 92-20. Adhesive mixed one month before molding. Machine had broken poppett. The twenty samples were subdivided into two groups of ten for study of adhesive application variations.
5. Samples 90-36 to 90-60.
6. Samples 91-11 to 91-35.
7. Samples 91-36 to 91-60.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS																		Sheet No. M11		
Job Operator: D. Pike			Mold Description: Rotating Band							Barrel/Screw: Standard						Safety Check Engineer: D. R. Askins				
Molding Date	Resin	Adhesive	Comment Code	Temperature (°F)					Press. (psi)		Cycle Times (sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)	
				Nozzle	Front	Rear	Mold Fixed	Mold Movable	Injection	Back	Injection	Open	Overall	Ram in Motion	Knob Setting	RPM				
10-16-74	Zytel 211	P104	1	500	500	500	230	230	550	125	16	55	120	2-3	B-0.0	---	1/8	Green 2	1-1/4	
10-17-74	Zytel 211	253P	2	500	500	500	230	230	550	125	16	55	120	2-3	B-0.0	---	1/8	Green 8	1-1/4	
2-7-75	Zytel 211	P104	3	500	500	500	230	230	550	125	16	55	120	2-3	B-0.0	120	1/8	Green 8	1-1/4	
4-8-75	Zytel 211	FM238/BR238	4	500	500	525	160	160	550	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8	
4-8-75	Zytel 211	FM1000/BR1009	5	500	500	525	160	160	550	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8	
4-8-75	Zytel 211	FM53U/BR53	6	500	500	525	160	160	550	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8	

Comments: All resin dried 2 hr. at 200°F for these operations.

1. Samples 92-21 to 92-45. Adhesive mixed six weeks prior to use.
2. Samples 90-61 to 90-85.
3. Samples 92-46 to 92-57.
4. Samples 93-1 to 93-5.
5. Samples 94-1 to 94-5.
6. Samples 95-1 to 95-5.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS

Sheet No. M12

Job Operator	Mold Description	Barrel/ Screw	Safety Check Engineer
D. Pike	Rotating Band	Standard	D. R. Askins

Molding Date	Resin	Adhesive	Comment Code	Temperature (°F) Nozzle	Front	Rear	Mold Fixed	Mold Movable	Press. (psi) Injection	Back	Cycle Times (sec.) Injection	Open	Overall	Ram in Motion	Screw Speed Knob Setting	RPM	Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)
3-18-75	Noryl EN265	FM53U / 253P	1	550	525	500	200	200	700	125	26	55	120	2-4	3-6.0	60	1/8	Green 3	1-1/8
3-18-75	Noryl EN265	FM53U	2	550	525	500	200	200	700	125	26	55	120	2-4	3-6.0	60	1/8	Green 3	1-1/8
3-18-75	Noryl EN265	FM53U / BR53	3	550	525	500	200	200	700	125	26	55	120	2-4	3-6.0	60	1/8	Green 3	1-1/8
3-19-75	Noryl EN265	Hysol 4405	4	575	600	600	200	200	700	125	26	55	120	2-4	3-6.0	60	1/8	Green 4	1-3/8
3-20-75	Noryl EN265	FM53 / 253P	5	575	600	600	200	200	700	125	26	55	120	2-4	3-6.0	60	1/8	Green 4	1-3/8
3-20-75	Noryl EN265	FM53	6	575	600	600	200	200	700	125	26	55	120	2-4	3-6.0	60	1/8	Green 4	1-3/8
3-20-75	Noryl EN265	FM53 / BR53	7	575	600	600	200	200	700	125	26	55	120	2-4	3-6.0	60	1/8	Green 4	1-3/8
3-28-75	Noryl EN265	FM53U	8	600	600	500	220	220	700	175	16	55	120	2-3	3-6.0	65	1/16	Green 2	1-1/4

Comments: Resin dried 2 hr. at 220°F for all of above operations except 3-28-75, which was 2 hr. at 245°F.

1. Samples 21-1 to 21-6. 253P adhesive was applied and prebaked according to its normal process and used as a primer for the FM53U adhesive film.
2. Samples 21-7 to 21-12. The FM53U film was applied directly to the cleaned projectile surface.
3. Samples 21-13 to 21-18. The recommended BR53 primer was used under the FM53U film.
4. Samples 22-1 to 22-10. These ten were subdivided into five groups of two for study of various drying periods between adhesive application and molding.
5. Samples 21-19 to 21-22. 253P primer as in comment #1 above. This group divided into two sets of two for study of two different cure schedules.
6. Samples 21-23 to 21-26. No primer used. Group divided as in comment #5 for study of two cure schedules.
7. Samples 21-27 to 21-30. BR53 primer. Group divided as in comment #5 for study of two cure schedules.
8. Samples 21-31 to 21-42. No primer used. This group of twelve subdivided into six groups of two for study of various adhesive precure schedules before molding.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS — Sheet No. M13

Job Operator	Mold Description	Barrel/Screw	Safety Check Engineer
D. Pike	Rotating Band	Standard	D. R. Askins

Molding Date	Resin	Adhesive	Comment Code	Temperature (°F) Nozzle	Front	Rear	Mold Fixed	Mold Movable	Press. (psi) Injection	Back	Cycle Times (sec.) Injection	Open	Overall	Ram in Motion	Screw Speed Knob Setting	RPM	Cushion (inch)	Feed Rate Setting Screw color)	Total Feed Setting (inch)
4-4-75	Noryl EN265	FM1000/BR53	1	600	600	500	220	220	700	175	16	55	120	2-3	B-6.0	65	1/16	Green 2	1-1/4
5-27-75	Noryl EN265	FM1000/BR1009	2	600	600	500	220	220	700	175	16	55	120	2-3	B-6.0	65	1/16	Green 2	1-1/4
6-2-75	Noryl EN265	FM1000/BR1009	3	600	600	500	220	220	700	175	16	55	120	2-3	B-6.0	65	1/16	Green 2	1-1/4

Comments: Resin dried 2 hr. at 245°F in all of above operations.

1. Samples 23-1 to 23-16. These sixteen subdivided into four equal groups for study of various projectile surface preparations and adhesive curing techniques.
2. Samples 24-1 to 24-5.
3. Samples 24-6 to 24-15. These ten subdivided into four groups of two or three for study of various adhesive application processes and adhesive cure schedules.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS																			Sheet No. M14	
Job Operator D. Pike			Mold Description Rotating Band							Barrel/ Screw Standard						Safety Check Engineer D. R. Askins				
Molding Date	Resin	Adhesive	Comment Code	Temperature (°F)					Press.(psi)		Cycle Times(sec.)				Screw Speed		Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)
				Nozzle	Front	Rear	Mold Fixed	Mold Movable	Injection	Back	Injection	Open	Overall	Ram in Motion	Knob Setting	RPM			
4-14-75	Plaskon 8231	253P	1	500	500	525	160	160	500	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8
4-14-75	Plaskon 8231	P3	2	500	500	525	160	160	500	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8
4-15-75	Plaskon 8231	P104	3	500	500	525	160	160	500	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8
4-15-75	Plaskon 8233	253P	4	500	500	525	160	160	600	125	16	55	120	2-3	B-2.0	120	1/8	Green 6	1-1/8
4-15-75	Plaskon 8233	P3	5	500	500	525	160	160	600	125	16	55	120	2-3	B-2.0	120	1/8	Green 6	1-1/8
4-15-75	Plaskon 8233	P104	6	500	500	525	160	160	600	125	16	55	120	2-3	B-2.0	120	1/8	Green 6	1-1/8

Comments: Resin dried 2 hr. at 200°F in all of above operations.

1. Samples 100-1 to 100-6.
2. Samples 101-1 to 101-6.
3. Samples 102-1 to 102-6.
4. Samples 110-1 to 110-6.
5. Samples 111-1 to 111-6.
6. Samples 112-1 to 112-6.

MOLDING DATA RECORD - Newbury Eldorado 3V-75RS			Sheet No. M15
Job Operator: D. Pike	Mold Description: Rotating Band	Barrel/ Screw: Standard	Safety Check Engineer: D. R. Askins

Molding Date	Resin	Adhesive	Comment Code	Temperature (°F) Nozzle	Front	Rear	Mold Fixed	Mold Movable	Press. (psi) Injection	Back	Cycle Times (sec.) Injection	Open	Overall	Ram in Motion	Screw Speed Knob Setting	RPM	Cushion (inch)	Feed Rate Setting (Screw color)	Total Feed Setting (inch)
5-7-75	Plaskon 8231 / Zytel 211	253P	1	500	500	525	160	160	500	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8
5-7-75	Plaskon 8231 / Zytel 211	P3	2	500	500	525	160	160	500	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8
5-23-75	Plaskon 8231 / Zytel 211	253P	3	500	500	525	150	160	500	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8
5-23-75	Plaskon 8231 / Zytel 211	P3	4	500	500	525	160	160	500	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8
5-23-75	Plaskon 8231 / Zytel 211	P104	5	500	500	525	160	160	500	125	16	55	120	2-3	B-2.0	120	1/8	Green 3	1-1/8
6-16-75	Plaskon 8231 / L1901	253P	6	600	500	500	250	250	600	125	15	30	60	2-3	B-7.5	40	1/16	Green 1	1-1/8

Comments:

Resins dried 2 hr. at 200°F in all of above operations.

1. Samples 120-1 to 120-10. These ten subdivided into two groups of five for study of adhesive application variables.
2. Samples 121-1 to 121-10. These ten subdivided into two groups of five for study of adhesive application variables.

1&2 - Plaskon 8231 mixed 50:50 with Zytel 211 to give a 7% glass content resin.

3. Samples 130-1 to 130-5.
4. Samples 131-1 to 131-5.
5. Samples 132-1 to 132-5.

3, 4, & 5 - Plaskon 8231 mixed 25:75 with Zytel 211 to give a 3-1/2% glass content resin.

6. Samples 135-1 to 135-12. These twelve subdivided into four groups of three for study of two band lengths and two projectile surface preparations. Plaskon 8231 mixed 25:75 with L1901 to give a 3-1/2% glass content.

APPENDIX C

TEST DATA

This section presents the results of both falling dart screening tests and gunfire tests conducted upon samples of all the different rotating band/ adhesive/processing variable combinations investigated during this program. The information is organized so the reader can cross reference the test results obtained for any single specimen with the processing and molding parameters used in the fabrication of that specimen and tabulated in Appendix B. The notations P1 through P14 and M1 through M15 refer, respectively, to the sheet numbers upon which the processing or molding data is recorded in Appendix B.

20 mm ROTATING BAND TEST DATA								Sheet No. D1
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
2	50-1	P1	M1	Fall. Dart	75		Fail	Bandfractured and debonded from substrate.
2	50-2	P1	M1	Fall. Dart	75		Fail	Band fractured and debonded from substrate.
2	50-3	P1	M1	Gun Fire	75		Fail	Entire band lost.
2	50-5	P1	M1	Gun Fire	75		Fail	Entire band lost.
4	82-3	P1	M1	Fall. Dart	75	These seven samples were	Fail	Slight fracturing. Substantial debonding.
4	50-1	P1	M1	Fall. Dart	75	induction heated to a variety	Fail	Fracture and debonding.
4	70-5	P1	M1	Fall. Dart	75	of different temps. to en-	Fail	Slight fracturing. Substantial debonding
4	85-1	P1	M1	Fall. Dart	75	hance surface wetting. All	Fail	Slight fracturing. Substantial debonding.
4	50-5	P1	M1	Fall. Dart	75	the samples ultimately saw	Fail	No fracture, some debonding.
4	53-6	P1	M1	Fall. Dart	75	a max. temp. of 500°F during	Fail	Fracture, complete debonding
4	AG	P1	M1	Fall. Dart	75	their various induct. heating schedules.	Fail	No fracture, some debonding.
6	53-1	P1	M1	Fall. Dart	75		Fail	Band fractured and debonded from substrate.
6	53-5	P1	M1	Fall. Dart	75		Fail	Band fractured and debonded from substrate.
6	53-3	P1	M1	Gun Fire	75		Fail	Entire band lost.
6	53-4	P1	M1	Gun Fire	75		Fail	Entire band lost.
7	50-4	P1	M1	Fall. Dart	75	These seven samples were	Fail	Fracture. Substantial debonding.
7	50-6	P1	M1	Fall. Dart	75	induct. heated to a variety of	Fail	Fracture. Substantial debonding.
7	50-3	P1	M1	Fall. Dart	75	different temps. to enhance sur-	Fail	Fracture. Substantial debonding
7	70-1	P1	M1	Fall. Dart	75	face wetting. All the samples	Fail.	Fracture. Substantial debonding.
7	50-2	P1	M1	Fall. Dart	75	ultimately saw a max. temp.	Fail	Fracture. Substantial debonding.
7	70-6	P1	M1	Fall. Dart	75	of 500°F during their various	Fail	Fracture. Substantial debonding.
7	53-x	P1	M1	Fall. Dart	75	induct. heating schedules.	Fail	Fracture. Substantial debonding.
8	53-12	P1	M1	Fall. Dart	75		Fail	Fracture. Substantial debonding.
8	53-24	P1	M1	Fall. Dart	75		Fail	Fracture. Substantial debonding.
9	60-3	P1	M2	Fall. Dart	75		Fail	Band fractured and entirely debonded.
9	60-5	P1	M2	Fall. Dart	75		Fail	Band fractured and entirely debonded.
10	20-4	P1	M2	Fall. Dart	75		Fail	Slight fracture. Substantial debonding.
10	20-7	P1	M2	Fall. Dart	-65		Fail	Fracture and debonding.
10	20-8	P1	M2	Fall. Dart	75		Pass	No fracture or debonding.
10	20-10	P1	M2	Fall. Dart	-65		Fail	Fracture and debonding.

20 mm ROTATING BAND TEST DATA								Sheet No. D2
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
11	65-1	P2	M2	Fall. Dart	75		Fail	No fracture but entire band debonded.
11	65-5	P2	M2	Fall. Dart	75	Only impacted with 4 ft. lbs. rather than 8.	Fail	No fracture but entire band debonded.
12	65-1	P2	M2	Fall. Dart	75		Fail	Fracture and complete debonding.
13	10-1	P2	M2	Fall. Dart	75		Pass	
13	10-1	P2	M2	Fall. Dart	-65		Fail	Fracture and partial debonding.
13	10-2	P2	M2	Fall. Dart	75		Pass	
13	10-2	P2	M2	Fall. Dart	-65		Fail	Fracture and partial debonding.
13	10-3	P2	M2	Fall. Dart	75		Pass	
13	10-3	P2	M2	Fall. Dart	-65		Fail	Fracture and partial debonding.
14	10-11	P2	M2	Fall. Dart	75		Pass	
14	10-11	P2	M2	Fall. Dart	-65		Fail	Fracture and partial debonding.
14	10-12	P2	M2	Fall. Dart	75		Pass	
14	10-12	P2	M2	Fall. Dart	-65		Fail	Fracture and partial debonding.
14	10-15	P2	M2	Fall. Dart	-65	Only impacted with 2 ft. lbs. instead of 8.	Pass	
15	10-17	P2	M2	Fall. Dart	75		Pass	
15	10-17	P2	M2	Fall. Dart	-65		Fail	Fracture and partial debonding.
15	10-18	P2	M2	Fall. Dart	75		Pass	
15	10-18	P2	M2	Fall. Dart	-65		Fail	Fracture and partial debonding.
15	10-16	P2	M2	Fall. Dart	-65	Impacted with 4 ft. lbs. instead of 8.	Fail	Fracture and partial debonding.
15	10-19	P2	M2	Fall. Dart	-65	Impacted with 3 ft. lbs. instead of 8	Pass	
16	34-6	P2	M9	Fall. Dart	75		Fail	Fracture and total debonding.
17	33-4	P2	M9	Fall. Dart	75		Fail	Fracture and substantial debonding.
18	30-1	P2	M9	Fall. Dart	75		Fail	Fracture and partial debonding.
19	31-1	P2	M9	Fall. Dart	75		Fail	Fracture and total debonding.
20	32-5	P2	M9	Fall. Dart	75		Fail	Fracture and substantial debonding.

20 mm ROTATING BAND TEST DATA								Sheet No. D3
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
21	80-5	P3	M3	Fall. Dart	75	Impacted with 2 ft. lb. instead of 8.	Fail	Complete debonding.
22	80-3	P3	M3	Fall. Dart	75		Pass	
22	80-4	P3	M3	Gun Fire	75		Fail	Large section lost.
22	80-2	P3	M3	Gun Fire	-65		Fail	Half of band lost.
22	80-5	P3	M3	Gun Fire	-65		Fail	Most of band lost.
22	80-6	P3	M3	Gun Fire	165		Pass	Slight fraying on rear edge.
23	50-5	P3	M3	Fall. Dart	75		Pass	
23	80-9	P3	M3	Gun Fire	75		Pass	
23	53-5	P3	M3	Gun Fire	75		Pass	
23	65-4	P3	M3	Gun Fire	75		Pass	
23	53-4	P3	M3	Gun Fire	-65		Fail	Small piece off front edge. Rest of band OK.
23	65-5	P3	M3	Gun Fire	-65		Pass	
23	80-3	P3	M3	Gun Fire	165		Pass	
23	80-8	P3	M3	Gun Fire	165		Pass	
23	53-3	P3	M3	Gun Fire	165		Pass	
23	65-6	P3	M3	Gun Fire	165		Pass	
24	80-15	P3	M3	Fall. Dart	75		Pass	
24	80-15	P3	M3	Fall. Dart	155		Pass	
24	80-20	P3	M3	Fall. Dart	75		Pass	
24	80-20	P3	M3	Fall. Dart	-65		Fail	Fracture and partial debonding.
24	80-25	P3	M3	Fall. Dart	75		Pass	
25	80-28	P3	M3	Fall. Dart	75		Pass	
25	80-28	P3	M3	Fall. Dart	-65		Fail	Fracture and partial debonding.
25	80-30	P3	M3	Fall. Dart	-65		Marginal	Very slight fracture and debonding.
25	80-35	P3	M3	Fall. Dart	75		Pass	
25	80-3[illegible]	P3	M3	Fall. Dart	-65		Fail	Fracture and partial debonding.
26	82-3	P3	M3	Fall. Dart	75		Pass	

20 mm ROTATING BAND TEST DATA								Sheet No. D4
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
27	82-3	P3	M3	Fall. Dart	75		Pass	
27	82-1	P3	M3	Gun Fire	75		Fail	Most of band is lost.
27	82-4	P3	M3	Gun Fire	75		Pass	
27	82-5	P3	M3	Gun Fire	75		Fail	Rear half of band lost.
27	82-6	P3	M3	Gun Fire	75		Fail	Small pieces lost off rear half of band.
28	85-3	P3	M4	Fall. Dart	75	Impacted with 13 ft. lb. instead of 8.	Fail	Entire band debonded. No fracture.
28	85-4	P3	M4	Fall. Dart	75	Impacted with 2 ft. lb. instead of 8.	Fail	No fracture. Some debonding.
29	85-1	P3	M4	Fall. Dart	75	Impacted with 4 ft. lb. instead of 8.	Fail	Small amount of debonding. No fracture.
29	85-5	P3	M4	Fall. Dart	75		Pass	
30	85-1	P3	M4	Fall. Dart	75		Pass	
30	85-2	P3	M4	Gun Fire	75		Pass	
30	85-3	P3	M4	Gun Fire	75		Pass	
30	85-4	P3	M4	Gun Fire	75		Pass	
30	85-5	P3	M4	Gun Fire	75		Pass	
30	85-6	P3	M4	Gun Fire	75		Pass	
31	85-13	P3	M4	Fall. Dart	75		Pass	
31	85-17	P3	M4	Fall. Dart	75		Pass	
31	85-24	P3	M4	Fall. Dart	75		Pass	
31	85-24	P3	M4	Fall. Dart	-65		Fail	Slight fracture and debonding
31	85-28	P3	M4	Fall. Dart	75		Pass	
31	85-28	P3	M4	Fall. Dart	155		Pass	
32	70-5	P4	M5	Fall. Dart	75		Pass	
32	70-2	P4	M5	Fall. Dart	75		Fail	Entire band missing.
32	70-3	P4	M5	Fall. Dart	75		Fail	Entire band missing.
32	70-4	P4	M5	Fall. Dart	75		Fail	Entire band missing.
33	75-4	P4	M5	Fall. Dart	75		Fail	No fracture but entire band debonded.
34	75-1	P4	M5	Fall. Dart	75	Impacted with 4 ft. lb. instead of 8.	Fail	Some fracture and debonding.

20 mm ROTATING BAND TEST DATA								Sheet No. D5
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
35	75-5	P4	M5	Fall. Dart	75		Pass	
35	75-3	P4	M5	Gun Fire	75		Fail	Entire band lost.
35	75-6	P4	M5	Gun Fire	75		Fail	Several parts of band lost.
36	50-1	P4	M5	Fall. Dart	75		Fail	Fracture and partial debonding.
36	75-10	P4	M5	Gun Fire	75		Fail	Entire band lost.
37	75-13	P4	M5	Fall. Dart	75		Pass	
37	75-13	P4	M5	Fall. Dart	-65		Fail	Fracture and partial debonding.
37	75-12	P4	M5	Gun Fire	75		Fail	Band almost entirely lost.
37	75-14	P4	M5	Gun Fire	75		Pass	Slight fraying at rear edge.
37	75-15	P4	M5	Gun Fire	75		Pass	Photo blurred. Hard to tell condition of
38	75-17	P4	M5	Fall. Dart	75	-	Pass	
38	75-21	P4	M5	Fall. Dart	-65		Fail	Fracture and debonding.
38	75-23	P4	M5	Fall. Dart	-65	Impacted at 4 ft. lb. instead of 8.	Fail	Fracture and debonding.
38	75-25	P4	M5	Fall. Dart	-65	Impacted at 4 ft. lb. instead of 8.	Fail	Fracture and debonding.
39	75-38	P4	M5	Fall. Dart	75		Pass	
39	75-40	P4	M5	Fall. Dart	-65	Impacted at 6 ft. lbs. instead of 8.	Fail	Fracture and debonding.
40	77-6	P4	M6	Fall. Dart	75		Fail	Fracture and partial debonding.
40	77-8	P4	M6	Fall. Dart	-75		Fail	Fracture and partial debonding.
40	77-8	P4	M6	Fall. Dart	-165		Pass	
41	77-1	P4	M6	Fall. Dart	75		Fail	Fracture and partial debonding
41	77-4	P4	M6	Fall. Dart	75		Fail	Fracture and partial debonding.
42	76-1	P5	M6	Fall. Dart	75		Pass	Very slight fracture and debonding.
42	76-1	P5	M6	Fall. Dart	-65		Fail	Fracture and partial debonding.
42	76-6	P5	M6	Fall. Dart	75		Pass	
42	76-6	P5	M6	Fall. Dart	-65		Fail	Fracture and partial debonding.
42	76-3	P5	M6	Gun Fire	75		Pass	Very small piece lost from rear edge.
42	76-4	P5	M6	Gun Fire	75		Fail	Several small chunks off front and rear.
42	76-7	P5	M6	Gun Fire	75		Fail	One-fourth of band lost.
42	76-8	P5	M6	Gun Fire	75		Fail	Large piece lost.

20 mm ROTATING BAND TEST DATA								Sheet No. D6
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
43	76-21	P5	M6	Fall. Dart	75		Pass	
43	76-35	P5	M6	Fall. Dart	-65		Fail	Fracture and partial debonding.
43	76-11	P5	M6	Gun Fire	75		Pass	Photo blurred but looks OK. May be fraying.
43	76-12	P5	M6	Gun Fire	75		Fail	Small peice off rear edge.
43	76-23	P5	M6	Gun Fire	75		Pass	Photo blurred but looks OK. May have lost small piece.
43	76-26	P5	M6	Gun Fire	75		Pass	Photo blurred but looks OK. May have lost small piece on rear edge.
43	76-30	P5	M6	Gun Fire	75		Fail	Photo blurred but some pieces look lost.
44	76-36	P5	M6	Fall. Dart	75		Pass	
44	76-35	P5	M6	Fall. Dart	-65		Fail	Fracture and slight debonding.
44	76-37	P5	M6	Gun Fire	75		Fail	Photo blurred but large chunk appears missing.
45	76-43	P5	M6	Fall. Dart	75		Pass	Very small chip at rear edge. No debonding.
45	76-53	P5	M6	Fall. Dart	-65	Impacted with 4 ft. lb. instead of 8.	Fail	Fracture and debonding.
46	76-63	P5	M6	Fall. Dart	75	Impacted with 4 ft. lb. instead of 8.	Pass	Small chips at front and rear edges. No debonding.
46	76-67	P5	M6	Fall. Dart	-65		Fail	Fracture and debonding.
47	67-16	P6	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
47	67-16	P6	M7	Fall. Dart	-65		Fail	Fracture and partial debonding.
47	67-22	P6	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
48	67-25	P6	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
48	67-35	P6	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
49	67-45	P6	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
50	67-50	P6	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
51	68-2	P6	M7	Fall. Dart	75		Fail	Fracture and substantial debonding.
51	68-6	P6	M7	Fall. Dart	75		Fail	Slight fracture and debonding
52	68-11	P6	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
53	68-16	P6	M7	Fall. Dart	75		Fail	Fracture and substantial debonding.
54	68-21	P6	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
55	68-26	P6	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
56	41-1	P7	M8	Fall. Dart	75		Fail	Fracture and partial debonding.
57	41-11	P7	M8	Fall. Dart	75		Fail	Fracture and partial debonding.
57	41-12	P7	M8	Fall. Dart	75		Fail	Fracture and partial debonding.
58	12-5	P7	M8	Fall. Dart	75		Fail	Fracture and partial debonding.

20 mm ROTATING BAND TEST DATA								Sheet No. D7
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
59	12-11	P7	M8	Fall. Dart	75		Fail	Fracture and partial debonding.
59	12-12	P7	M8	Fall. Dart	75		Fail	Fracture and partial debonding.
60	40-8	P7	M8	Fall. Dart	75		Fail	Fracture and partial debonding.
61	10-11	P7	M8	Fall. Dart	75		Fail	Fracture and partial debonding.
61	40-12	P7	M8	Fall. Dart	75		Fail	Fracture and partial debonding.
62	13-2	P7	M8	Fall. Dart	75		Pass	No fracture. Very slight debonding.
62	43-4	P8	M8	Fall. Dart	75		Fail	Fracture and partial debonding.
63	90-1	P8	M10	Fall. Dart	75		Fail	No fracture. Partial debonding.
63	90-6	P8	M10	Fall. Dart	75		Fail	No fracture. Partial debonding.
64	90-11	P8	M10	Fall. Dart	75		Pass	
64	90-15	P8	M10	Fall. Dart	75		Pass	
64	90-15	P8	M10	Fall. Dart	-65		Fail	Fracture and substantial debonding.
64	90-18	P8	M10	Fall. Dart	75		Pass	
64	90-19	P8	M10	Fall. Dart	75		Pass	
64	90-19	P8	M10	Fall. Dart	-65		Fail	Fracture and substantial debonding.
64	90-21	P8	M10	Fall. Dart	75		Fail	No fracture. Slight debonding.
64	90-21	P8	M10	Fall. Dart	-65		Fail	Fracture and substantial debonding.
64	90-22	P8	M10	Fall. Dart	75		Fail	No fracture. Some debonding.
64	90-23	P8	M10	Fall. Dart	75		Fail	No fracture. Slight debonding.
64	90-23	P8	M10	Fall. Dart	-65		Fail	Fracture and substantial debonding.
64	90-13	P8	M10	Gun Fire	75		Pass	Slight fraying at rear.
64	90-14	P8	M10	Gun Fire	75		Fail	Substantial piece lost.
64	90-16	P8	M10	Gun Fire	75		Fail	Substantial piece lost.
64	90-17	P8	M10	Gun Fire	75		Fail	Substantial piece lost.
65	90-43	P8	M10	Fall. Dart	75		Fail	Fracture and partial debonding.

20 mm ROTATING BAND TEST DATA								Sheet No. D8
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
66	90-69	P8	M11	Fall. Dart	75		Pass	
66	90-81	P8	M11	Fall. Dart	-65	Band had 15° and 6° bevels on front and rear edges.	Fail	Fracture and debonding.
66	90-61	P8	M11	Gun Fire	75		Pass	
66	90-65	P8	M11	Gun Fire	75		Pass	
66	90-71	P8	M11	Gun Fire	75		Pass	
66	90-77	P8	M11	Gun Fire	75		Pass	Photo dark. Looks OK but may be slight fraying and small pieces lost.
66	90-82	P8	M11	Gun Fire	75		Pass	Photo blurred. Looks OK but may be slight fraying...
66	90-64	P8	M11	Gun Fire	75	Band had 15° and 6° bevels on front and rear edges.	Pass	
66	90-68	P8	M11	Gun Fire	75	Band had 15° and 6° bevels on front and rear edges.	Pass	
66	90-75	P8	M11	Gun Fire	75	Band had 15° and 6° bevels on front and rear edges.	Pass	
66	90-76	P8	M11	Gun Fire	75	Band had 15° and 6° bevels on front and rear edges.	Pass	
66	90-85	P8	M11	Gun Fire	75	Band had 15° and 6° bevels on front and rear edges.	Pass	
66	90-62	P8	M11	Gun Fire	-65	Band had 15° and 6° bevels on front and rear edges.	Pass	
66	90-66	P8	M11	Gun Fire	-65	Band had 15° and 6° bevels on front and rear edges.	Pass	
66	90-72	P8	M11	Gun Fire	-65	Band had 15° and 6° bevels on front and rear edges.	Fail	Large piece missing.
66	90-78	P8	M11	Gun Fire	-65	Band had 15° and 6° bevels on front and rear edges.	Pass	
66	90-83	P8	M11	Gun Fire	-65	Band had 15° and 6° bevels on front and rear edges.	Fail	Photo hard to interpret. May be OK or may have lost very small piece.
66	90-63	P8	M11	Gun Fire	165	Band had 15° and 6° bevels on front and rear edges.	Pass	
66	90-67	P8	M11	Gun Fire	165	Band had 15° and 6° bevels on front and rear edges.	Fail	Photo dark and blurred. May be OK.
66	90-74	P8	M11	Gun Fire	165	Band had 15° and 6° bevels on front and rear edges.	Fail	Photo blurred. Appears to be slight fraying.
66	90-80	P8	M11	Gun Fire	165	Band had 15° and 6° bevels on front and rear edges.	Pass	
66	90-84	P8	M11	Gun Fire	165	Band had 15° and 6° bevels on front and rear edges.	Fail	Photo dark and blurred. May be OK or may have lost very small piece.
67	91-6	P8	M10	Fall. Dart	75		Fail	No fracture. Slight debonding.
67	91-10	P8	M10	Fall. Dart	75		Pass	
67	91-10	P8	M10	Fall. Dart	-65		Fail	Fracture and partial debonding.
67	91-5	P8	M10	Fall Dart	-65		Pass	

20 mm ROTATING BAND TEST DATA								Sheet No. D9
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
68	91-24	P8	M10	Fall. Dart	75		Pass	
68	91-24	P8	M10	Fall. Dart	-65		Fail	Fracture and partial debonding.
68	91-23	P8	M10	Gun Fire	75		Fail	No pieces lost but some fraying evident.
68	91-27	P8	M10	Gun Fire	75		Pass	
68	91-28	P8	M10	Gun Fire	75		Fail	No pieces lost but limited fraying.
68	91-34	P8	M10	Gun Fire	75		Pass	
68	91-17	P8	M10	Gun Fire	75	Band had 15° and 6° bevels on front and rear edges.	Pass	
68	91-18	P8	M10	Gun Fire	75	Band had 15° and 6° bevels on front and rear edges.	Pass	Photo dark. May be small piece lost from rear edge.
68	91-21	P8	M10	Gun Fire	75	Band had 15° and 6° bevels on front and rear edges.	Pass	
68	91-29	P8	M10	Gun Fire	75	Band had 15° and 6° bevels on front and rear edges.	Pass	
68	91-32	P8	M10	Gun Fire	75	Band had 15° and 6° bevels on front and rear edges.	Pass	
68	91-19	P8	M10	Gun Fire	-65	Band had 15° and 6° bevels on front and rear edges.	Pass	Photo dark. May be small piece lost from rear edge.
68	91-26	P8	M10	Gun Fire	-65	Band had 15° and 6° bevels on front and rear edges.	Fail	Small piece lost from rear edge.
68	91-30	P8	M10	Gun Fire	-65	Band had 15° and 6° bevels on front and rear edges.	Pass	
68	91-33	P8	M10	Gun Fire	-65	Band had 15° and 6° bevels on front and rear edges.	Fail	Small piece lost from rear edge.
68	91-11	P8	M10	Gun Fire	165	Band had 15° and 6° bevels on front and rear edges.	Pass	
68	91-12	P8	M10	Gun Fire	165	Band had 15° and 6° bevels on front and rear edges.	Pass	Photo dark & blurred. May be a few very small pieces lost from rear edge.
68	91-16	P8	M10	Gun Fire	165	Band had 15° and 6° bevels on front and rear edges.	Pass	
68	91-25	P8	M10	Gun Fire	165	Band had 15° and 6° bevels on front and rear edges.	Pass	
68	91-35	P8	M10	Gun Fire	165	Band had 15° and 6° bevels on front and rear edges.	Pass	Very slight fraying at rear edge.

20 mm ROTATING BAND TEST DATA								Sheet No. D10
Combination Number	Specimen Number	Location of Pressing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
69	91-60	P8	M10	Fall. Dart	75		Pass	
69	91-60	P8	M10	Fall. Dart	-65		Fail	Fracture and partial debonding.
69	91-55	P8	M10	Fall. Dart	75		Pass	
69	91-55	P8	M10	Fall. Dart	-65		Fail	Fracture and substantial debonding.
69	91-50	P8	M10	Fall. Dart	75		Pass	
69	91-50	P8	M10	Fall. Dart	-65		Fail	No fracture. Slight debonding.
69	91-41	P8	M10	Fall. Dart	-65	Band had 15° & 6° bevels on front and rear edges.	Fail	Fracture and partial debonding.
69	91-38	P8	M10	Gun Fire	75		Fail	Photo dark & blurred. May be OK but may have lost small piece.
69	91-47	P8	M10	Gun Fire	75		Pass	
69	91-54	P8	M10	Gun Fire	75		Pass	May be tiny fragment off at rear edge.
69	91-56	P8	M10	Gun Fire	75		Pass	
69	91-43	P8	M10	Gun Fire	75	Band had 15 & 6° bevels on front and rear edges.	Pass	Some fraying at rear edge.
69	91-44	P8	M10	Gun Fire	75	Band had 15° & 6° bevels on front and rear edges.	Pass	Some fraying at rear edge.
69	91-52	P8	M10	Gun Fire	75	Band had 15° & 6° bevels on front and rear edges.	Pass	
69	91-53	P8	M10	Gun Fire	75	Band had 15° & 6° bevels on front and rear edges.	Pass	
69	91-57	P8	M10	Gun Fire	75	Band had 15° & 6° bevels on front and rear edges.	Pass	May be very slight fraying.
69	91-47	P8	M10	Gun Fire	-65	Band had 15° & 6° bevels on front and rear edges.	Fail	Small piece lost from rear edge.
69	91-45	P8	M10	Gun Fire	-65	Band had 15° & 6° bevels on front and rear edges.	Pass	Photo dark & blurred. May be small piece off rear edge.
69	91-46	P8	M10	Gun Fire	-65	Band had 15° & 6° bevels on front and rear edges.	Pass	
69	91-51	P8	M10	Gun Fire	-65	Band had 15° & 6° bevels on front and rear edges.	Pass	Photo blurred.
69	91-58	P8	M10	Gun Fire	-65	Band had 15° & 6° bevels on front and rear edges.	Pass	Photo blurred.
69	91-37	P8	M10	Gun Fire	165	Band had 15° & 6° bevels on front and rear edges.	Pass	Photo blurred. May be small piece off rear edge.
69	91-39	P8	M10	Gun Fire	165	Band had 15° & 6° bevels on front and rear edges.	Pass	
69	91-40	P8	M10	Gun Fire	165	Band had 15° & 6° bevels on front and rear edges.	Pass	Photo blurred. May be small piece off rear edge.
69	91-48	P8	M10	Gun Fire	165	Band had 15° & 6° bevels on front and rear edges.	Pass	
70	92-9	P8	M10	Fall. Dart	75		Fail	Slight fracture and partial debonding.

20 mm ROTATING BAND TEST DATA								Sheet No. DII
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F^0)	Other Test Data	Observed Test Result	Additional comments on Test Results
71	92-12	P8	M10	Fall. Dart	75		Pass	
71	92-13	P8	M10	Fall. Dart	-65		Pass	
71	92-11	P8	M10	Gun Fire	75		Pass	
71	92-14	P8	M10	Gun Fire	75		Pass	
71	92-18	P8	M10	Gun Fire	75		Pass	
71	92-19	P8	M10	Gun Fire	75		Pass	
71	92-20	P8	M10	Gun Fire	75		Pass	
72	92-2[illegible]	P8	M11	Fall. Dart	75		Pass	
72	92-21	P8	M11	Gun Fire	75		Fail	Photo dark but appears to have lost part of band.
72	92-26	P8	M11	Gun Fire	75		Fail	Photo dark but some pieces may be off & some fraying.
72	92-30	P8	M11	Gun Fire	75		Fail	Photo blurred but part of band appears to have be[illegible] os[illegible]
72	92-25	P8	M11	Gun Fire	75	Band had 15° & 6° bevels on front and rear edges.	Pass	
72	92-29	P8	M11	Gun Fire	75	Band had 15° & 6° bevels on front and rear edges.	Pass	
72	92-35	P8	M11	Gun Fire	75	Band had 15° & 6° bevels on front and rear edges.	Pass	
72	92-39	P8	M11	Gun Fire	75	Band had 15° & 6° bevels on front and rear edges.	Pass	
72	92-45	P8	M11	Gun Fire	75	Band had 15° & 6° bevels on front and rear edges.	Pass	
72	92-22	P8	M11	Gun Fire	-65	Band had 15° & 6° bevels on front and rear edges.	Fail	Piece of band missing.
72	92-27	P8	M11	Gun Fire	-65	Band had 15° & 6° bevels on front and rear edges.	Fail	Almost entire band lost.
72	92-32	P8	M11	Gun Fire	-65	Band had 15° & 6° bevels on front and rear edges.	Pass	
72	92-37	P8	M11	Gun Fire	-65	Band had 15° & 6° bevels on front and rear edges.	Fail	Piece missing from rear half of band.
72	92-42	P8	M11	Gun Fire	-65	Band had 15° & 5° bevels on front and rear edges.	Pass	
72	92-23	P8	M11	Gun Fire	165	Band had 15° & 6° bevels on front and rear edges.	Fail	Photo dark but looks like a piece is missing.
72	92-28	P8	M11	Gun Fire	165	Band had 15° & 6° bevels on front and rear edges.	Fail	Photo blurred but large piece appears to be missing.
72	92-38	P8	M11	Gun Fire	165	Band had 15° & 6° bevels on front and rear edges.	Fail	Badly peeled.
72	92-43	P8	M11	Gun Fire	165	Band had 15° & 6° bevels on front and rear edges.	Fail	Photo dark and blurred. May be OK.
73	92-19	P8	M11	Fall. Dart	-65	Impacted with 4 ft. lb. instead of 8.	Fail	Fracture and partial debonding.
73	92-50	P8S	M11	Fall. Dart	-65		Fail	Fracture and partial debonding.
74	93-3	P9	M11	Fall. Dart	75		Fail	Fracture and debonding at primer-projectile interface.
74	93-3	P9	M11	Fall. Dart	-65		Fail	Fracture and debonding at primer-projectile interface.

20 mm ROTATING BAND TEST DATA								Sheet No. D12
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
75	94-5	P9	M11	Fall. Dart	75		Pass	
75	94-5	P9	M11	Fall. Dart	-65		Fail	Fracture & substantial debonding at adhesive-plastic interface
76	95-1	P9	M11	Fall. Dart	75		Fail	No fracture. Substantial debonding.
76	95-1	P9	M11	Fall. Dart	-65		Fail	Fracture & complete debonding at both metal&plastic interfaces
76	95-3	P9	M11	Fall. Dart	75		Fail	No fracture. Substantial debonding.
76	95-3	P9	M11	Fall. Dart	-65		Fail	Fracture & complete debonding at both metal&plastic interfaces
77	69-9	P9	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
78	69-15	P9	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
79	69-20	P9	M7	Fall. Dart	75		Fail	Fracture and slight debonding.
80	69-23	P9	M7	Fall. Dart	75		Fail	Fracture and partial debonding.
81	21-2	P10	M12	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
81	21-3	P10	M12	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
81	21-1	P10	M12	Fall. Dart	-65		Fail	Fracture and debonding at plastic-adhesive interface.
82	21-5	P10	M12	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
82	21-6	P10	M12	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
82	21-4	P10	M12	Fall. Dart	-65		Fail	Fracture and debonding at plastic-adhesive interface.
83	21-8	P10	M12	[illegible]	75		Fail	Fracture and debonding at plastic-adhesive interface.
83	21-7	P10	M12	Dart	-65		Fail	Fracture and debonding at plastic-adhesive interface.
84	21-11	P10	M12	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
84	21-10	P10	M12	Fall. Dart	-65		Fail	Fracture and debonding at plastic-adhesive interface.
85	21-14	P10	M12	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
85	21-13	P10	M12	Fall. Dart	-65		Fail	Fracture and debonding at plastic-adhesive interface.
86	21-17	P10	M12	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
86	21-16	P10	M12	Fall. Dart	-65		Fail	Fracture and debonding at plastic-adhesive interface.
87	21-19	P10	M12	Fall. Dart	75		Fail	No fracture. Very slight debonding at plastic-adhesive interface.
87	21-20	P10	M12	Fall. Dart	-65		Fail	No fracture. Very slight debonding at plastic-adhesive interface.
88	21-21	P10	M12	Fall. Dart	75		Fail	No fracture. Very slight debonding at plastic-adhesive interface.
88	21-22	P10	M12	Fall. Dart	-65		Fail	No fracture. Very slight debonding at plastic-adhesive interface.
89	21-23	P10	M12	Fall. Dart	75		Fail	No fracture. Very slight debonding at plastic-adhesive interface.
89	21-24	P10	M12	Fall. Dart	-65		Fail	No fracture. Very slight debonding at plastic-adhesive interface.

20 mm ROTATING BAND TEST DATA								Sheet No. D13
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
90	21-25	P10	M12	Fall. Dart	75		Fail	No fracture. Very slight debonding at plastic-adhesive interface.
90	21-26	P10	M12	Fall. Dart	-65		Fail	No fracture. Very slight debonding at plastic-adhesive interface.
91	21-27	P10	M12	Fall. Dart	75		Fail	No fracture. Very slight debonding at plastic-adhesive interface.
91	21-28	P10	M12	Fall. Dart	-65		Fail	Fracture & debonding at primer-metal interface.
92	21-29	P10	M12	Fall. Dart	75		Fail	No fracture. Very slight debonding at plastic-adhesive interface.
92	21-30	P10	M12	Fall. Dart	-65		Fail	Fracture and debonding at plastic-adhesive interface.
93	21-31	P11	M12	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
94	21-34	P11	M12	Fall. Dart	75		Fail	Fracture & total debonding at plastic-adhesive interface.
95	21-35	P11	M12	Fall. Dart	75		Fail	Fracture & partial debonding at plastic-adhesive interface.
96	21-37	P11	M12	Fall. Dart	75		Fail	Fracture & partial debonding at plastic-adhesive interface.
97	21-39	P11	M12	Fall. Dart	75		Fail	Fracture & partial debonding at plastic-adhesive interface.
98	21-42	P11	M12	Fall. Dart	75		Fail	Fracture & partial debonding at plastic-adhesive interface.
99	22-2	P11	M12	Fall. Dart	75		Fail	Fracture and debonding.
99	22-1	P11	M12	Fall. Dart	-65		Fail	Fracture and debonding.
100	22-4	P11	M12	Fall. Dart	75		Fail	No fracture. Very slight debonding.
100	22-3	P11	M12	Fall. Dart	-65		Fail	Fracture and debonding.
101	22-6	P11	M12	Fall. Dart	75		Fail	No fracture. Very slight debonding.
101	22-5	P11	M12	Fall. Dart	-65		Fail	Fracture and debonding.
102	22-8	P11	M12	Fall. Dart	75		Fail	No fracture. Very slight debonding.
102	22-7	P11	M12	Fall. Dart	-65		Fail	Fracture and debonding.
103	22-10	P11	M12	Fall. Dart	75		Fail	No fracture. Very slight debonding.
103	22-9	P11	M12	Fall. Dart	-65		Fail	Fracture and debonding.
104	23-1	P12	M13	Fall. Dart	75		Pass	
104	23-1	P12	M13	Fall. Dart	-65		Fail	No fracture. Very slight debonding.
104	23-2	P12	M13	Fall. Dart	-65		Fail	Fracture & debonding at metal-adhesive interface.
105	23-5	P12	M13	Fall. Dart	75		Pass	
105	23-5	P12	M13	Fall. Dart	-65		Fail	Debonding at metal-adhesive interface.
106	23-7	P12	M13	Fall. Dart	75		Fail	Fracture & very slight debonding at metal-adhesive interface
106	23-7	P12	M13	Fall. Dart	-65		Fail	Fracture & very slight debonding at metal-adhesive interface

20 mm ROTATING BAND TEST DATA								Sheet No. D14
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
107	23-9	P12	M13	Fall. Dart	75		Pass	
107	23-9	P12	M13	Fall. Dart	-65		Fail	Fracture & debonding at metal-adhesive interface.
108	23-13	P12	M13	Fall. Dart	75		Pass	
108	23-13	P12	M13	Fall. Dart	-65		Fail	Fracture & substantial debonding at metal-adhesive interface
109	23-16	P12	M13	Fall. Dart	75		Pass	
109	23-16	P12	M13	Fall. Dart	-65		Fail	Fracture & substantial debonding at metal-adhesive interface
110	24-1	P12	M13	Fall. Dart	75		Pass	Very slight debonding.
110	24-1	P12	M13	Fall. Dart	-65		Fail	Fracture and debonding at both interfaces.
110	24-2	P12	M13	Fall. Dart	-65		Fail	Fracture and debonding at both interfaces.
110	24-5	P12	M13	Fall. Dart	165		Pass	Very slight debonding.
111	24-6	P12	M13	Fall. Dart	75		Pass	Very slight debonding.
111	24-7	P12	M13	Fall. Dart	-65		Fail	Fracture and debonding at metal-adhesive interface.
112	24-8	P12	M13	Fall. Dart	75		Pass	Very slight debonding at plastic-adhesive interface.
112	24-9	P12	M13	Fall. Dart	-65		Fail	Fracture and debonding at metal-adhesive interface.
113	24-10	P12	M13	Fall. Dart	75		Pass	Very slight debonding at both interfaces.
113	24-11	P12	M13	Fall. Dart	75		Pass	Very slight debonding at both interfaces.
113	24-12	P12	M13	Fall. Dart	-65		Pass	Very slight debonding at both interfaces.
114	24-13	P12	M13	Fall. Dart	75		Fail	Debonding at metal-adhesive interface.
114	24-14	P12	M13	Fall. Dart	75		Fail	Debonding at metal-adhesive interface.
114	24-15	P12	M13	Fall. Dart	-65		Fail	Debonding at metal-adhesive interface.
115	100-4	P13	M14	Fall. Dart	75		Fail	Fracture and debonding at metal-adhesive interface.
115	100-1	P13	M14	Fall. Dart	165		Fail	Fracture and debonding at metal-adhesive interface.
116	101-3	P13	M14	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
116	101-4	P13	M14	Fall. Dart	165		Fail	Fracture and debonding at plastic-adhesive interface.
117	102-2	P13	M14	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
117	102-3	P13	M14	Fall. Dart	165		Fail	Fracture and debonding at plastic-adhesive interface.
118	110-4	P13	M14	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
118	110-6	P13	M14	Fall. Dart	165		Fail	Fracture and debonding at plastic-adhesive interface.

20 mm ROTATING BAND TEST DATA								Sheet No. D15
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
119	111-2	P13	M14	Fall. Dart	75		Fail	Fracture & debonding at plastic-adhesive interface.
119	111-5	P13	M14	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
119	111-1	P13	M14	Fall. Dart	165		Fail	Fracture and debonding at plastic-adhesive interface.
119	111-4	P13	M14	Fall. Dart	165		Fail	Fracture and debonding at plastic-adhesive interface.
120	112-1	P13	M14	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
120	112-6	P13	M14	Fall. Dart	165		Fail	Fracture and debonding at plastic-adhesive interface.
121	120-3	P13	M15	Fall. Dart	75		Pass	
121	120-3	P13	M15	Fall. Dart	-65		Fail	No fracture. Debonding at both interfaces.
122	120-7	P13	M15	Fall. Dart	75		Pass	
122	120-7	P13	M15	Fall. Dart	-65		Fail	Fracture and debonding at both interfaces.
123	130-3	P13	M15	Fall. Dart	75		Pass	
123	130-3	P13	M15	Fall. Dart	-65		Fail	Fracture and debonding at both interfaces.
123	130-5	P13	M15	Fall. Dart	165		Pass	
124	121-4	P14	M15	Fall. Dart	75		Fail	Fracture and debonding at plastic-adhesive interface.
124	121-4	P14	M15	Fall. Dart	-65		Fail	Fracture and debonding at plastic-adhesive interface.
125	121-7	P14	M15	Fall. Dart	75		Fail	Fracture, some debonding at both interfaces, but most at metal-adhesive.
125	121-7	P14	M15	Fall. Dart	-65		Fail	Fracture, some debonding at both interfaces, but most at metal-adhesive.
126	131-2	P14	M15	Fall. Dart	75		Pass	
126	131-2	P14	M15	Fall. Dart	-65		Fail	Fracture and debonding at plastic-adhesive interfaces.
126	131-3	P14	M15	Fall. Dart	165		Pass	
127	132-2	P14	M15	Fall. Dart	75		Pass	
127	132-2	P14	M15	Fall. Dart	-65		Fail	Fracture and debonding at plastic-adhesive interface.
127	132-4	P14	M15	Fall. Dart	75		Fail	Fracture and debonding.
127	132-3	P14	M15	Fall. Dart	165		Pass	
128	135-1	P14	M15	Fall. Dart	75		Pass	
128	135-2	P14	M15	Fall. Dart	-65	Impacted at 2 ft. lb. instead of 8.	Fail.	Fracture and debonding.
128	135-3	P14	M15	Fall. Dart	-65	Impacted at 2 ft. lb. instead of 8.	Fail	Fracture and debonding.
129	135-4	P14	M15	Fall. Dart	75	Impacted at 2 ft. lb. instead of 8.	Fail	Fracture and debonding.
129	135-5	P14	M15	Fall. Dart	-65	Impacted at 2 ft. lb. instead of 8.	Fail	Fracture and debonding.
129	135-6	P14	M15	Fall. Dart	-65	Impacted at 2 ft. lb. instead of 8.	Fail	Fracture and debonding.

20 mm ROTATING BAND TEST DATA								Sheet No. D16
Combination Number	Specimen Number	Location of Processing Data	Location of Molding Data	Type of Test	Test Temp. (F°)	Other Test Data	Observed Test Result	Additional comments on Test Results
130	135-7	P14	M15	Fall Dart	75		Pass	
130	135-8	P14	M15	Fall Dart	-65	Impacted at 2 ft. lb. instead of 8.	Fail	Fracture and debonding.
130	135-9	P14	M15	Fall Dart	-65	Impacted at 2 ft. lb. instead of 8.	Fail	Fracture and debonding.
131	135-10	P14	M15	Fall Dart	75	Impacted at 2 ft. lb. instead of 8.	Fail	Fracture and debonding.
131	135-11	P14	M15	Fall Dart	-65	Impacted at 2 ft. lb. instead of 8.	Fail	Fracture and debonding.
131	135-12	P14	M15	Fall Dart	-65	Impacted at 2 ft. lb. instead of 8.	Fail	Fracture and debonding.

REFERENCES

1. Larsen, W.S., Steidley, R.B., Bilsbury, S.J., and Heiney, O.K., "Development of a Plastic Rotating Band for High Performance Projectiles," AFATL-TR-74-106, July, 1974.

2. Eig, Merrill, "Evaluation and Critique on Use of Polymeric Materials as Rotating Bands on 20mm Projectiles," Technical Report 4358, AMCMS Code 502E. 11.295, Picatinney Arsenal, Dover, N.J., September, 1972.

3. Weggemans, D.M., "Adhesive Application Charts," Adhesives Age, Vol. 16, No. 10, P. 31, October, 1973.

☆ U. S. GOVERNMENT PRINTING OFFICE 1976 — 657-630/469